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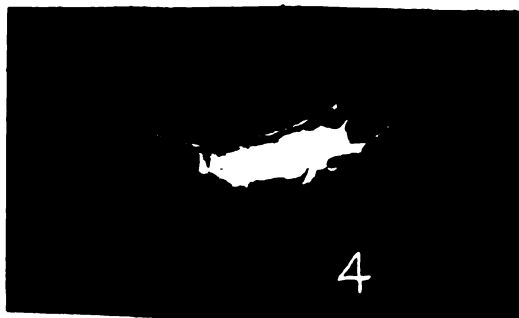
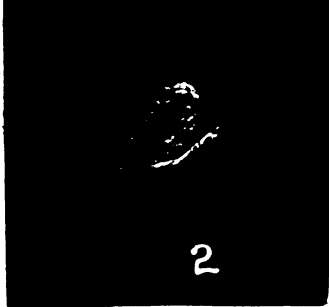
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**VOLUME XIX.**

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# INDEX.—VOLUME XIX.

	PAGE		PAGE
<i>Acherontemys heckmani</i> .. ..	11	<i>Chitra indica</i> .. ..	29
<i>Acrobasis inficita</i> .. ..	44	<i>Citripestis sagittiferella</i> ..	50
Alligator, Terrapius, The ..	9	<i>Colpochelys</i> .. ..	17
<i>Ampycophora holophaea</i> .. ..	42	<i>Conobathra automorpha</i> ..	49
" <i>metamalenella</i> .. ..	42	<i>Corcyra cephalonica</i> .. ..	52
<i>Ancylodes penicillata</i> .. ..	46	<i>Cotachena aluensis</i> .. ..	59
<i>Anerastris biseriella</i> .. ..	43	" <i>histicalis</i> .. ..	59
" <i>enervilla</i> .. ..	43	<i>Crambus cuniferellus</i> .. ..	55
" <i>opificella</i> .. ..	43	" <i>leptogrammellus</i> ..	55
" <i>plinthina</i> .. ..	43	<i>Crocodile, The Estuarine</i> ..	5
" <i>rhodoneura</i> .. ..	43	<i>Crocodyles, The</i> .. ..	4
Annual Meeting, Proceedings of	1	<i>Crocodylus johnsonii</i> .. ..	2, 4, 5
Aquatic Plants in Enoggera Res- voir, List of .. ..	124	" <i>porosus</i> .. ..	2, 5
<i>Argyria amoenaalis</i> .. ..	55	" <i>palustris</i> .. ..	5
<i>Banisia dohertyi</i> .. ..	40	<i>Cryptoblabes adoceta</i> .. ..	51
" <i>elongata</i> .. ..	40	" <i>dissolutella</i> .. ..	51
" <i>ypsilon</i> .. ..	40	" <i>euraphella</i> .. ..	51
Bennett, F.: .. ..		" <i>oenobarella</i> .. ..	51
The Botany of Irvinebank and its immediate neighbourhood	65	<i>Culladia admigratella</i> .. ..	55
<i>Bombifrons</i> .. ..	4	<i>Curicta oppositalis</i> .. ..	58
<i>Bostra disticha</i> .. ..	60	<i>Dermochelys coriacea</i> .. ..	2, 8
Botany of Irvinebank and its im- mediate neighbourhood ..	65	<i>Devisia mythodes</i> .. ..	2, 3, 11
Cameron J.: .. ..		<i>Doloessa castanella</i> .. ..	53
The Results of Science in the Development of Commerce	iii	<i>Diadescia parodes</i> .. ..	56
<i>Caouana caratta</i> .. ..	21	<i>Diptychophora diargema</i> ..	57
<i>Caretta atra</i> .. ..	17	" <i>ochracealis</i> .. ..	57
" <i>caretta</i> .. 3, 17, 21, 22		<i>Diploseustis perieresalis</i> ..	59
<i>Carettochelys insculpta</i> ..	2, 28	Disease Garden, A .. ..	73
" <i>insculptus</i> .. ..	28	Education in Queensland ..	v-
<i>Catamola capnopis</i> .. ..	60	<i>Elseya dentata</i> .. ..	3
" <i>fumerea</i> .. ..	60	<i>Enmalocera longiramella</i> ..	44
<i>Chelodina expansa</i> .. ..	3	<i>Emydosaurian and Testudinian</i> Reptiles of New Guinea, Catalogue of .. ..	1
" <i>longicollis</i> .. ..	3, 23	<i>Emys Macquaria</i> .. ..	25
" <i>noræ guineæ</i> .. ..	3, 23	<i>Emydura australis</i> .. ..	3
" <i>oblonga</i> .. ..	3	" <i>albertisii</i> .. ..	3, 26
" <i>Tiebenrocki</i> .. ..	3, 23, 30	" <i>Krefftii</i> .. ..	3, 31
<i>Chelone imbricata</i> .. ..	21	" <i>latisternum</i> .. ..	3
" <i>nydas</i> .. ..	20	" <i>macquariæ</i> .. ..	25
<i>Chelonia dussumieri</i> .. ..	22	" <i>macquarii</i> .. ..	3, 25
" <i>imbricata</i> .. ..	21	" <i>novæ-guinææ</i> .. ..	3, 27
" <i>mydas</i> .. ..	2, 17, 20	" <i>subglobosa</i> .. ..	3, 26
" <i>marmorata</i> .. ..	20	<i>Endotricha aglaspa</i> .. ..	58
<i>Chelydra argillarum</i> .. ..	11	" <i>caustopa</i> .. ..	58
" <i>murchisoni</i> .. ..	11	" <i>dispurgens</i> .. ..	58
" <i>Terpentina</i> .. ..	10	" <i>mesenterialis</i> .. ..	58
<i>Chelymys Krefftii</i> .. ..	31	" <i>puncticostalis</i> .. ..	58
" <i>macquaria</i> .. ..	25	" <i>pyrosalis</i> .. ..	58
" <i>Victoriæ</i> .. ..	25, 31	<i>Epicrocis subignalis</i> .. ..	51
<i>Chilo lativittalis</i> .. ..	57	<i>Epipaschia cletolis</i> .. ..	61
" <i>ocellea</i> .. ..	56	" <i>lygropa</i> .. ..	62
" <i>ocelleus</i> .. ..	56	<i>Eretinochelys imbricata</i> ..	3, 17, 21
		<i>Erythphlebia enervilla</i> ..	43
		<i>Eromene ocellæa</i> .. ..	56

# INDEX—Continued.

	PAGE		PAGE
Estuarine Crocodile, The .. ..	5	Meseiniadia infractalis .. ..	47
Etiella behri .. ..	52	Mesopemta polyphoralis .. ..	41
"  melanella .. ..	52	Microsca marginepunctalis .. ..	39
"  Walsinghamella .. ..	52	"  subrosealis .. ..	40
Eucallionyma .. ..	55	Myeloid grossipunctella .. ..	48
Eucampyla .. ..	44	Nephopteryx capnoessa .. ..	51
Euchelys macropus .. ..	20	"  infractalis .. ..	47
Euchelymys sulcifera .. ..	24	"  nodicornella .. ..	50
"  subglobosa .. ..	26	"  euraphella .. ..	51
Euchromius ocellus .. ..	56	Norton, Hon. A. (M.L.C.):	
Euzophera thermochroa .. ..	46	Notes of Travel .. ..	91
Euzopherodes albicans .. ..	45	Nyctereutica .. ..	60
"  leptocosma .. ..	45	Ogilby, J. Douglas:	
Fossifrontia leuconeurella .. ..	42	Catalogue of Emydosaurian	
Gymnopus indicus .. ..	29	and Testudinian Reptiles	
Harpagoneura hepialivora .. ..	54	of New Guinea .. ..	1
Henderson, J. Brownlie:		Onychochelys Kraussi .. ..	21
Education in Queensland .. ..	v.	Oophilis .. ..	4
Heosphora chlorogramma .. ..	41	Othaga mnesibrya .. ..	63
"  euryzona .. ..	41	"  perenodes .. ..	63
Heteromicta nigricostella .. ..	53	Papua latilimbella .. ..	44
"  ochraceola .. ..	53	"  longiramella .. ..	44
"  pachytera .. ..	53	Parramatta .. ..	44
"  poeodes .. ..	54	Paralipsa .. ..	53
Homoeosoma albocostalis .. ..	47	Pelochelys cantorii .. ..	3, 29
"  farinaria .. ..	44	"  cantoris .. ..	29
"  vagella .. ..	44	Philas .. ..	4
Hydraspis macquarii .. ..	25	Phycita auchmodes .. ..	50
Hyphantidium albicostale .. ..	46, 47	"  automorpha .. ..	49
"  apodectum .. ..	47	"  ceroprepiella .. ..	49
"  hemibaphes .. ..	47	"  corethropus .. ..	49
"  leucarmum .. ..	47	"  eulepidella .. ..	49
"  quadrigitellum .. ..	47	"  recondita .. ..	49
Hypopgryhia rufasciella .. ..	48	"  sagittiferella .. ..	49
Hypophana petalocosma .. ..	51	Plants, common about Irvine	
Hypsidia erythropsalis .. ..	60	bank, List of .. ..	70
Hypolamprus marginepunctalis .. ..	39	Platenys novæ guineæ .. ..	27
"  leopardatus .. ..	40	Poujadia erodella .. ..	43
"  subrosealis .. ..	40	"  inficita .. ..	44
Hypotropha chlorogramma .. ..	41	"  opificella .. ..	43
"  euryzona .. ..	41	Pound, C. J.:	
"  stereosticha .. ..	41	On Trypanosonia and their	
Irvinebank, and its immediate		presence in the blood of	
neighbourhood, The Botany		Brisbane rats .. ..	33
of .. ..	65	Presidential Address:	
Lagoon, Description of a typical		The Results of Science on	
Queensland .. ..	105	the Development of	
Lammoria oenochroa .. ..	55	Commerce .. ..	iii.
Lamoria adeptella .. ..	55	Education in Queensland .. ..	v.
"  pachylepidella .. ..	55	Pseudemydura umbrina .. ..	3, 24
Luth, The .. ..	8	Ptyobathra hypolepidota .. ..	49
Macalla aeruginosa .. ..	60	Pylaidæ and Thyrididæ, A	
"  concisella .. ..	60	preliminary revision of the	
"  dochmoscia .. ..	61	Australian .. ..	39
"  mniasias .. ..	60	Pyraxis semitessellaris .. ..	40
Macroclernys .. ..	11	"  bastialis .. ..	41
Maliarpha minimella .. ..	42	"  manihotalis .. ..	59
Melissoblaptæ cissinobaphes .. ..	90	"  polygraphalis .. ..	41
"  hilaropis .. ..	53	"  polyphoralis .. ..	41
"  homochroa .. ..	53	Rhodoneura bastialis .. ..	41
"  sordidella .. ..	53	"  dissimulans .. ..	40
"  unicolor .. ..	53	"  dohertzi .. ..	40
"  parasiticus .. ..	54	"  elongata .. ..	40

# INDEX—Continued.

	PAGE		PAGE
" furcifera ..	40	Titanoceros catanantha ..	60
" loxomita ..	39	Tortoise, The Fly River ..	28
" melilialis ..	41	" Cantor's Soft-shelled ..	29
" polygraphalis ..	41	" Krefft's Mud ..	31
" scitaria ..	40	Tortoises and Turtles, The ..	7
" semitessellata ..	40	The Side-necked ..	22
" stenosoma ..	40	" Long-necked river ..	23
" Theorina ..	40	" New Guinea long-	
" ypsilon ..	40	necked ..	23
Salebria ceroprepiella ..	49	" Mud ..	24
Sclerobia tritralis ..	52	" Soft-shelled ..	27
Sedenia aspata ..	57	" Elephant ..	29
cervalis ..	57	Travel, Notes on ..	91
leucopepla ..	57	Trissonca capnoessa ..	51
rupalis ..	57	epiterpes ..	48
Spatulipalpia dissolutella ..	51	ianthemis ..	48
sophonica ..	51	Trypanosoma and their presence	
Sphargio coriacea ..	8	on the blood of Brisbane	
Stenachroia myrmecophila ..	54	rats, On ..	33
Stereobela leucomera ..	52	Turner, A. Jefferis, M.D.:	
Strighina hyalospiis ..	40	A Preliminary Revision of the	
Syntypica aleurodes ..	45	Australian Thyrididæ and	
Talis bivittella ..	58	Pyrallida ..	39
brunnea ..	58	Turtle, Bastard ..	17
icelomorpha ..	90	The green ..	20
pedionoma ..	90	" Hawk's Bill ..	21
Terrapin, The American Al-		" Loggerheaded ..	22
ligator ..	10	" Leathery ..	9
Terrapins, the Alligator ..	9	" New Guinea Snapping	11
Testudinian and Enrydosaur-		Turtles, The ..	17
ian Reptiles of New Guinea,		Turtles and Tortoises, The ..	7
Catalogue of, ..	1	The Leathery ..	8
Testudo coriacea ..	8	Tylochaeres cosmiella ..	48
caretta ..	17, 22	ianthemis ..	48
imbricata ..	17, 21	Ubida holomochla ..	56
mydas ..	17, 20	ramostriella ..	56
Thagora canstanella ..	53	Unadilla apatelia ..	45
Thalassochryels caretta ..	22	distichella ..	5
Thomson, John (M.B.)—		Vitessa glaucoptera ..	59
A Disease Garden ..	73	zalmira ..	59
Thyrididæ and Pyralidæ: A		Wasteneys, H.:	
preliminary revision of the		Description of a Typical Queens-	
Australian ..	39	land Lagoon ..	105
Tirathaba acrocausta ..	54	Water, Methods of Rendering	
chlorosema ..	54	Water Fit for a Town Supply	105
parasitica ..	54		
rufivena ..	54		

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**VOLUME XIX.**  
**PART I.**

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# CONTENTS.

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	PAGE
CATALOGUE OF THE EMYDOSAURIAN AND TESTUDINIAN REPTILES OF NEW GUINEA — <i>J. Douglas Ogilby</i> , April 23rd, 1904 ...	1
ON TRYPANOSOMA AND THEIR PRESENCE IN THE BLOOD OF BRISBANE RATS.— <i>C. J. Pound</i> , <i>F.R.M.S.</i> , September 3rd., 1904 ...	33
A PRELIMINARY REVISION OF THE AUS- TRALIAN THYRIDIDAE AND PYRALIDAE (PART II).— <i>A. Jefferis Turner</i> , <i>M.D.</i> , <i>F.E.S.</i> , January 2nd., 1905 ... ..	39
THE BOTANY OF IRVINEBANK AND ITS IMMEDIATE NEIGHBOURHOOD.— <i>F. Ben- nett</i> , November 19th, 1904.... ..	65
PRESIDENTIAL ADDRESS ... ..	i

# CATALOGUE OF THE EMYDOSAURIAN AND TESTUDINIAN REPTILES OF NEW GUINEA.

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**By J. DOUGLAS OGILBY.**

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*Read before the Royal Society of Queensland 23rd April, 1904.*

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ALTHOUGH the diagnosis of a recent chelydroid tortoise, here for the first time described from a species indigenous to the eastern hemisphere, was primarily intended to be the full aim of this paper, and naturally is still its chief consideration, it has occurred to me that an analytical list of all the species at present known to inhabit New Guinea, written in a concise and intelligible form, would be of great advantage to zoologists and collectors in that country, where the opportunities of consulting works of reference are few and far between. A secondary object which I have in view in so greatly enlarging the scope of this paper is to stimulate local observation and encourage explorers and others—traders, miners, etc.—whose occupations bring them in touch with the inland districts, to make more careful inquiries concerning the testudinian fauna and more extensive collections of the various species, most of which are known to science from a few specimens only.\* I would especially draw their attention to the two

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\*The testudinian reptiles lend themselves beyond all other chordates to amateur collecting, since, though the entire animal is necessarily more valuable to the scientific student, the easily preserved shell (carapace and plastron) is the most important factor in the differentiation of species.

large fresh water tortoises discovered in the Fly River by that indefatigable explorer, Sir William Macgregor, during his term of office as Lieutenant-Governor of British New Guinea. Of the first of these, *Carettochelys insculpta*, Ramsay (see p. 28), only the typical specimen and two imperfect skulls are known, while the second is represented by a single example in the collection of the Queensland Museum, described (see p. 11) below as *Devisia mythodes*. From the large size and remarkable appearance of these two species it is impossible but that they are well known to the natives; and if they are, as from their apparent rarity seems probable, decadent forms, it is all the more vitally necessary that the sum of the knowledge possessed by the natives, both recent and legendary, of their habits, breeding, food, and other points of their domestic economy, should be collected and collated with the least possible delay. New Guinea has always been noted for the beauty, wealth, and singularity of its avifauna, and as far as my experience goes the fresh water fauna—reptilian batrachian, and ichthyic—is equally interesting and remarkable. I am firmly of opinion that in these branches of zoological science there lies in Papua a rich and prolific field of research as yet unexplored or merely touched.

Before proceeding to the discussion of the various genera and species it will be interesting to contrast in parallel columns the forms which are respectively indigenous to Australia and Papua.

The species which are preceded by an asterisk (\*) are desiderata in the Queensland Museum.

## AUSTRALIAN.

## PAPUAN.

## Order I. Emydosauria.

## Family Crocodilidæ.

## CROCODILUS.

1. *Crocodylus johnstonii*.2. " *porosus*.1. *Crocodylus porosus*.

## Order II. Testudinata.

## Family I. Sphargididæ.

## I. DERMOCHELYS.

1. *Dermochelys coriacea*.1. *Dermochelys coriacea*.

## Family II. Chelydridæ.

## II. DEVISIA.

2. *Devisia mythodes*.

## Family III. Cheloniidæ.

## III. CHELONIA.

2. *Chelonia mydas*.3. *Chelonia mydas*.

#### IV. ERETNOCHELYS.

3. *Eretmochelys imbricata*.                      4. *Eretmochelys imbricata*.

## V. CARETTA.

4. *Caretta caretta*. 5. *Caretta caretta*.

**Family IV. Chelyvidæ.**

## VI. CHELODINA.

5. *Chelodina longicollis*. \*6. *Chelodina norœ-guineæ*.  
\*6. *expansa*. \*7. „ *siebenrocki*.  
\*7. *oblonga*.

## VII. PSEUDEMYDRA.

- \*8. *Pseudemydura umbrina*.

## VIII. EMYDURA.

- |      |                           |      |                           |
|------|---------------------------|------|---------------------------|
| 9.   | <i>Emydura macquarii.</i> | 8.   | <i>Emydura macquarii.</i> |
| 10.  | „ <i>krefftii.</i>        | 9.   | „ <i>krefftii.</i>        |
|      |                           | *10. | „ <i>albertisii.</i>      |
| *11. | „ <i>australis.</i>       | 11.  | „ <i>subglobosa.</i>      |
| 12.  | „ <i>latisternum.</i>     | *12. | „ <i>novæ-guinæ.</i>      |

## IX. ELSEYA.

13. *Elseya dentata*.

**Family V. Carettochelyidæ.**

## X. CARETTOCHELYS.

- \*13. *Carettochelys insculpta*.

**Family VI. Trionychidæ.**

## XI. PELOCHELYS.

- \*14. *Pelochelys cantorii*.

A glance over the right hand column will show that five species have been added to the list of Papuan tortoises since the publication in 1889 of the British Museum Catalogue of Chelonians; these are the new chelydrid *Devisia mythodes*, the three chelyids *Chelodina siebenrocki*, *Emydura macquarii*, and *Emydura krefftii*, and the trionychid *Pelochelys cantorii*. It will also be seen that at the present time the number of species known to inhabit these two geographical areas is equal; all the indications, however, point to an ultimate preponderance of species in the Papuan subregion, when that subregion shall have been thoroughly explored, over its more extensive southern neighbour. For instance the discoveries in the Fly River country of *Emydura macquarii*, a typical tortoise of the southern districts of Australia, and in Dutch New Guinea of *Emydura krefftii*, a typical Queensland form, suggest the probability of such North Australian species as *Chelodina expansa*, *Chelodina oblonga*, *Emydura*

*latisternum*, and *Elseya dentata* being also natives of the dependency; furthermore no part of the subregion, except that under British rule, has been more than superficially examined, and even that portion by no means thoroughly.

## ORDER I. EMYDOSAURIA.

### THE CROCODILES.

Body lacertiform, depressed, protected by regular series of quadrangular horny scutes of varying size. Teeth present in the jaws, implanted in distinct sockets. Sternum present. (ἐμύς, a fresh water tortoise; σαύρα, a lizard.)

#### Family CROCODILIDÆ.

Nostrils opening at the extremity of the snout. Pupil vertical. Ears with mobile lids. Fore limb with five, hind limb with four well developed digits, the three inner clawed.

Fresh waters of tropical and subtropical regions, at least one species entering the sea. Genera six.

#### Genus CROCODILUS.

#### THE TRUE CROCODILES.

*Crocodilus*, Laurenti, Synops. Rept., p. 53, 1768 (*niloticus*); Boulenger, Catal. Chelon., etc., p. 277, 1889.

*Oöphilis*, Gray, Ann. & Mag. Nat. Hist., (3) x. 1862, p. 267 (*porosus*).

*Bombifrons*, Gray, l.c., p. 269 (*trigonops*=*palustris*).

*Philas*, Gray, Proc. Zool. Soc., 1874, p. 177 (*johnstonii*).

Snout more or less elongate. Seventeen to nineteen upper and fifteen lower teeth on each side; fifth maxillary tooth largest; fourth mandibular tooth usually fitting into a notch in the upper jaw\*; mandibular symphysis not extending beyond the eighth tooth. A dorsal shield formed of four or more longitudinal series of juxtaposed, keeled, bony scutes. (κροκόδειλος, the name of the crocodile of the Nile among the Ionians.)

Northern Australia, Western Polynesia, Southern Asia, Africa, and the warmer parts of America.

Only one species of crocodile has as yet been proved to inhabit New Guinea, but since two others—*Crocodilus johnstonii*, Krefft, from the northern half of Australia, and

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\*Specimens of *Crocodilus palustris* sometimes occur in which this tooth fits into a pit as in *Alligator*.

*Crocodilus palustris*, Lesson, from the Malay Archipelago westward to the Indian peninsula—may occur there, I have included them in the following synopsis.

- a. Snout very slender, the width of its base about  $\frac{1}{3}$  of its length, without distinct ridges; dorsal shield subcontinuous with the nuchal; limb-scales keeled 1. *johnstonii*.
- aa. Snout wide and rather short; dorsal shield well separated from the nuchal
- b. Width of snout at base  $\frac{2}{3}$  to  $\frac{4}{5}$  of its length; a longitudinal ridge in front of the eye; limb-scales smooth or nearly so . . . . . 2. *porosus*.
- bb. Width of snout at base  $\frac{1}{2}$  to  $\frac{3}{4}$  of its length; no pre-orbital ridge; limb-scales keeled . . . . . 3. *palustris*.

#### CROCODILUS POROSUS.

*Crocodilus porosus*, Schneider, Hist. Amph., ii. p. 159, 1801; Boulenger, Catal. Chelon., etc., p. 284, 1889.

*Crocodilus pondicerianus*, Günther, Rept. Brit. Ind., p. 62, pl. vii, 1864, Pondicherry.

#### THE ESTUARINE CROCODILE.

Head rough, about twice as long as wide at the base, with a more or less strong ridge on each side in front of the eye, the pair slightly converging anteriorly; mandibular symphysis extending to the fifth tooth. Four large nucha scutes forming a square, with one or two smaller ones on each side; postoccipital scutes usually absent. Dorsal shield formed of sixteen or seventeen transverse and four to eight longitudinal series of scutes. Limbs smooth or nearly so. Adult dark olive above; young pale olive, with large dark spots on the body and tail and dots on the head, (*porosus*, pitted.)

Length to 25 feet. A skull in the South Kensington Museum belonged to an individual said to have been no less than 33 feet in length; it was obtained at Bawisaul in the Bengal Presidency in 1840.

*Distribution*:—From India, Ceylon, and southern China through Malaysia to North Australia, New Guinea, the Solomon and Fiji Islands. This crocodile habitually enters salt water and is often seen at a considerable distance from the shore. In addition to being the largest it is also as might be expected, one of the most dangerous of all the crocodiles, freely attacking human beings.



NOTE :—In my paper on “Australian Crocodiles” published in the Society’s “Proceedings” for the current year,\* I make mention, when referring to the size to which this species attains, of a well authenticated example, captured in the Bengal Presidency, “which measured no less than thirty-three feet.” (p. 208.) That this exceptional size may, perhaps, in some rare instances be approximated in our own waters, the following statement, which is vouched for by a gentleman in whose integrity I place the most implicit confidence, would seem to show. He assures me that he has on several occasions heard from the lips of an old identity of the Mackay district, who had had from forty to fifty years’ experience in the middle and northern zones of the State, the story of the death of a crocodile, shot on the Pioneer River, which, when brought ashore, was found to measure thirty-two feet; even allowing for a little exaggeration this individual must have been greatly above the average of the Queensland type, which would barely if at all exceed the half of that length. My informant indeed states that of the scores of “alligators” which he has caught or seen caught, not one exceeded eighteen feet in length. Personally I have seen a mounted specimen that measured twenty-three feet.

As indicative of the strength and ferocity possessed by these reptiles and the indomitable tenacity of purpose by which they are animated, the following anecdote, related to me by the same gentleman from his personal experience, should be of absorbing interest. It appears that he had the rare good fortune of being an eye-witness, at within but a few yards’ distance, of one of those nameless and unnoted tragedies, which are doubtless of frequent occurrence in the ceaseless drama for ever unfolding itself amid the pregnant solitudes of our vast northern wilderness—a duel à *outrance* between a full-grown bull and one of these reptiles about sixteen feet long—between the lord of the forest and pasture and the lord of the river and lagune. His story was that while he and some friends were fishing in the Pioneer River, some miles above Mackay, a bull came down to drink within a short distance of the place where they were sitting; while in the act of quenching its thirst the crocodile seized it by the

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\*Proc. Roy. Soc. Queensland, XVIII., 1904, pp. 208 *et seq.*

snout, and then began one of the most awful struggles for supremacy between beast and reptile, which it is possible for the mind of man to conceive. At the outset the bull by sheer strength dragged its adversary from the water, but failed utterly in its attempt to shake off the tenacious grip of its stubborn foe; meanwhile, however, the agonized bellowings of the tortured brute had brought to its assistance all the cattle in the neighbourhood; these at once intrepidly attacked the common enemy, but without in the slightest degree causing it to relax its hold upon its helpless victim. So the terrible struggle raged backwards and forwards for a full half hour, until at length another bull by chance struck the crocodile under the forearm, and the horn entering deeply, enabled it to toss the reptile, which in falling broke its back, and was easily despatched by the infuriated cattle. By this time, however, as may be supposed, very little of the face of the victimized bull remained, and as it had also one of its fore legs broken, the poor suffering brute had to be killed. Assuredly such a Homeric struggle must have been worth going a long way to witness; beside its tragedy how pitiful and degrading appears the tinsel pomp of the arena! Mr. Milroy, to whom I am indebted for the above graphic description, believes that if they had been left alone to fight out their battle, victory would ultimately have declared itself on the side of the reptile.

For further information regarding its, habits, breeding, etc., see my paper on "Australian Crocodiles" above referred to.

## ORDER II. TESTUDINATA.\*

### THE TORTOISES AND TURTLES.

Body more or less fully encased in a bony shell, which consists of an upper piece, the carapace, and a lower, the plastron. Jaws without teeth, covered with a horny sheath so as to form a cutting edge. Sternum wanting. (*Testudo*, gen. *testudinis*, a tortoise.)

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\*I would greatly have preferred using the title *Chelonion* for this order of reptiles, but since that name properly belongs to the genus of which the green turtle is the type, it is inadmissible as an ordinal name.

## SUBORDER I. ATHECÆ.

Vertebrae and ribs free, separated from a bony exoskeleton. Skull without descending processes of the parietal bones. —*Boulenger*—(a, priv. ; *θήκη*, a box.)

## Family A. SPHARGIDIDÆ.\*

## THE LEATHERY TURTLES.

Shell without epidermal shields, the exoskeleton consisting of numerous small bony plates arranged like mosaic. Limbs paddle-shaped and clawless, the phalanges without condyles. Marine.

Monotypic.

## Genus I. DERMOCHELYS.

*Dermochelys*, Blainville, Journ. Phys., lxxxiii. 1816, p. 259 (*coriacea*); Boulenger, Catal. Chelon., p. 7, 1889.

*Sphargis*, Merrem, Tent., p. 19, 1829 (*mercurialis*=*coriacea*).

Dorsal shield completely, ventral incompletely ossified in the adult, the former with seven, the latter with five keels. Head covered with small shields. Upper jaw anteriorly with two triangular cusps situated between three deep notches; lower jaw with a single cusp, which fits in between the upper pair, when the mouth is closed. (*δέρμα*, skin; *χέλυς*, a tortoise.)

All tropical seas.

## I. DERMOCHELYS CORIACEA.

*Testudo coriacea*, Linnæus, Syst. Nat., i. p. 350. 1766.

*Sphargis coriacea*, Gray, Synops. Rept., i. p. 51, 1731: McCoy, Prodr. Zool. Vict., ii. dec. 11, pl. ci, 1885.

*Dermochelys coriacea*, Boulenger, Catal. Chelon., p. 10, 1889.

## THE LUTH.

Carapace broad in front, acutely pointed behind. Fore limbs narrow and falcate, as long as the dorsal shield in the young, shorter in the adult; hind limbs short and truncated. Dark brown to purplish black above, uniform or spotted with yellow; under surface of limbs and sometimes of throat pinkish or yellowish. (*coriacea*, leathery.)

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\*The Century Dictionary derives the generic name *Sphargis* from the latin *Sphargis* (gen. *Sphargidis*); if this be correct the family name should be *Sphargidide*. The word, however, is constructed more on a Greek than a Latin model, but no such word occurs in the dictionaries of either language to which I have access.

Length to at least 8 feet. (Nine feet *vide* McCoy.) The mounted example in the Queensland Museum measures 7 feet 8 inches.

Although typically belonging to the fauna of the tropics this turtle straggles far into temperate seas; it has been recorded from both sides of the English Channel, from the Cape of Good Hope, etc., and nearer home from the coasts of Victoria and New Zealand.

The specific name and the colloquial names "Leathery Turtle" or "Leather-back" have been given to this species because the body is covered with a thick leathery skin which completely envelopes the bony exoskeleton. Its food consists principally of fishes, mollusks, and crustaceans. The flesh of this turtle is not eaten.

#### SUB-ORDER II. THECOPHORA.

Dorsal vertebræ and ribs immovably united and expanded into bony plates forming a carapace. Parietals prolonged downwards, forming a suture with the pterygoids or separated from the latter by the interposition of the epipterygoid—*Boulenger*—. (*θήκη* a box; *φορέω*, I carry.)

#### Superfamily a. CRYPTODIRA.

Neck bending by a sigmoid curve in a vertical plane. Pelvis not ankylosed to the carapace and plastron. Digits with not more than three phalanges. A complete series of marginal bones connected with the ribs. (*κρυπτός*, hidden; *δειρή*, neck.)

#### Family B. CHELYDRIDÆ.

#### THE ALLIGATOR TERRAPINS.

Shell covered with epidermal horny shields; carapace comparatively small, with serrated posterior border; plastron small and cruciform; pectoral shields widely separated from the marginals; abdominal shields not in contact on the median line, separated from the marginals, which are twenty-three in number, by a series of inframarginals. Chin with one or more pair of small dermal appendages. Digits moderately elongate, webbed; phalanges with condyles; claws four. Tail long, crested above. Fluvial and palustrine. (*χέλυς*, a tortoise; *ὕδρα*, a water-snake.)

North America, east of Rocky Mountains, ranging southward into Ecuador; New Guinea; ? Australia.

The discovery of a fresh-water tortoise, referable to a family which has hitherto been regarded as exclusively confined to the northern and middle portion of the American continent, in an island so far removed from its present centre of distribution, is most remarkable, and cannot fail to be of great interest to all herpetologists.

With regard to the geographical distribution of the family it is noteworthy that the common American Alligator Terrapin (*Chelydra serpentina*) ranges southward to Ecuador,\* which State lies within about the same parallels of latitude as New Guinea. North America being now the acknowledged metropolis of the chelydrids, it is interesting to consider by what route this neogæan family travelled round to south-eastern New Guinea; and since it has never, so far as I am aware, been suggested that there was, at any bygone era of the earth's existence, land communication between Papuasia and the north-eastern regions of South America, similar to that which at two distinct periods undoubtedly existed between south-western America, south-eastern Australia, and South Africa, the conclusion is irresistibly forced upon us that the migration, *if migration there were*, must have been through eastern Asia, though even here we are confronted with the problem of its passage from island to island. Alternatively it may be held that the Old World was the original birthplace of the chelydrids, from whence they spread to the New World, and there, having multiplied under the favourable conditions of huge marshes and rivers and a scanty and nomadic population, exist in numbers even to the present day though practically annihilated elsewhere. And this again gives rise to another interesting speculation—whether similar or closely related genera may not still survive in the great marshes and river systems of the interior of the Chinese Empire, a vast territory the biology of which is but little understood. This is of course purely conjectural, but many important discoveries have had their origin in as small a basis of fact, and this suggestion may also be worth investigation. But we cannot dismiss the subject of distribution without some inquiry into the extinct forms. Like the recent

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\*It is also worth mentioning that Mr. Boulenger has recently described from Mount Victoria, New Guinea, a frog whose only congener is an indigene of Ecuador.

species these are few in number, two or at most three having been recognised. Two of these which have been unhesitatingly referred to the genus *Chelydra*\* belong to the Tertiary formations of Central Europe, while the third,† about the authenticity of which there is some doubt, the plastron being still unknown, comes from the Tertiary of Washington Territory.

Genus II. *DEVISIA*, gen. nov.

Orbit lateral. No supramarginal shields. Tail with irregular shields of variable size inferiorly.‡ (Named for Charles Walter de Vis, Director of the Queensland Museum, and author of many valuable papers on Australian zoology and palæontology.)

New Guinea; ? Queensland.

2. *DEVISIA MYTHODES*, sp. nov.§

THE NEW GUINEA SNAPPING TURTLE.

Head large and triangular, depressed, with two pair of parietal ridges, the inner pair converging and uniting to form a prominent point in the middle of the posterior border of the occiput; the outer pair parallel, each terminating in a point, which is situated further back than the mesial point. Diameter of orbit equal to the length of the snout and to the width of the concave interorbital space, and two thirds of the length of the mandibular symphysis. Nostrils small and circular, pierced in a single depressed vertical plate, which is wider than deep, is bordered on the sides and below by the maxillary sheath, and above by two small supranasal shields; a pair of large preoculars meeting on the median line, as also do the

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\**Chelydra murchisoni*: Miocene Rocks of Baden, and *Chelydra argyillarum*, Laube, Abhandl. Verein. Iotos, ii. 1900, p. 47, pl. ii. fig. 7. Brown Coal of Bavaria.

†*Acherontemys heckmani*, Hay, Proc. U.S. Nat. Mus., xxii. 1899, p. 23, pl. vi. Miocene of Washington Territory.

‡Owing to the taxidermist having opened the lower surface instead of one of the sides of the tail when mounting the specimen, it is difficult to see the exact arrangement of the lepidosis, but to all appearance it is as described above. In any case it approaches in this character nearer to *Macrolemys* than to *Chelydra*, between which it appears to form a connecting link, possessing characters otherwise confined to one or the other genus.

§The species is remarkable as being the only cryptodirous tortoise as yet discovered in the Australasian region.

supraoculars ; a single postocular on each side ; frontal shield strongly rugose, sublanceolate, its point wedged between the convergent parietal ridges ; parietal shields broken up into numerous squamiform plates, the largest of which form a series along the external slope of the inner ridge ; temporal shields two, the lower lateral and very large, the upper superior and much smaller. Cleft of mouth a little less than half the length of the head, the postictal groove half the length of the lower jaw. A pair of small mental barbels. Neck wrinkled and vermiculated,  $1\frac{3}{2}$  time the length of the head, the anterior half with a few scattered erect tubercles above.

Carapace ovate, its greatest width above the inguinal region ; its longitudinal diameter rather gently arched to the last vertebral shield, the posterior portion of which bends abruptly downwards to join the horizontal supracaudals ; its transverse diameter is strongly arched laterally, depressed and almost flattened mesially ; anteriorly it is feebly emarginate, the outer borders of the nuchal and margino-nuchal shields forming together a scarcely perceptible incurvature ; posteriorly it is rather weakly serrated.\* Nuchal shield crescentic, its anterior border expanded laterally in front of the margino-nuchals as narrow spiniform processes, the width between the posterior angles  $3\frac{1}{2}$  times its mesial length. Inner border of margino-nuchal  $1\frac{1}{2}$  time the outer border and  $2\frac{1}{2}$  times the greatest width ;—of first margino-brachial  $\frac{2}{3}$  of the outer and a little more than twice the width ; of second subequal to and more than thrice ;—of first-margino-lateral a little less than outer and  $2\frac{2}{3}$  times the width, of second  $\frac{1}{2}$  less than and  $1\frac{2}{3}$  time, of third a little less than and  $1\frac{1}{2}$  time, of fourth a little more than and  $1\frac{1}{3}$  time, of fifth subequal to and  $1\frac{1}{4}$  time ;—of first margino-femoral  $\frac{1}{8}$  less than the outer and  $1\frac{1}{3}$  time the width, of second  $\frac{1}{4}$  less and  $1\frac{1}{3}$  time, of third a little less and a little more ; supracaudals pentagonal, strongly angulated posteriorly, the suture between them reduced to a blunt point ; all the other marginal shields are quadrilateral, with the exception of the second and fourth marginolaterals and the first marginofemoral which are pentagonal, being angulated on their inner facies at their junction with the intercostal sutures. First vertebral shield tetragonal, with

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\*In comparison with the figures given by Duméril and Bibron and Lydekker.

its anterior border feebly emarginate, its lateral and posterior borders and all the angles broadly rounded, prominently arched behind, and like all the marginal shields, smooth ; its mesial length is  $\frac{5}{7}$  of its greatest width, which is a little behind the middle of the shield : second vertebral shield similarly shaped, but with the posterior border straighter and mesially emarginate, smooth, with two low wide convergent ridges running from the first costal suture to the emargination, immediately in front of which the ridges are highest and bear a few coarse striæ ; between the bases of the ridges the shield is markedly depressed, and there is a narrow border of fine striæ at the front and sides ; its mesial length is  $\frac{5}{7}$  of its greatest width, which is at the intersection of the first and second costals : third vertebral shield similar in size and shape to the second, but with the basal depression vestigial and crossed by broad transverse striæ, which beyond the ridges become longitudinal : fourth much smaller, but with the posterior knob stronger, and a median groove anteriorly, otherwise as third ; its mesial length  $\frac{5}{8}$  of its width at the junction of the third and fourth costals : fifth vertebral shield pentagonal, the anterior border straight, the outer borders sigmoidal, the posterior borders emarginate and meeting at a moderately obtuse angle, which almost separates the supracaudals ; the prominence is a little behind the middle of the shield, and is well developed ; from its front margin two shallow divergent grooves extend forwards to the outer ends of the anterior border ; its mesial length  $\frac{3}{4}$  of its greatest width at the intersection of the fourth costal and third marginofemoral shields. First costal shield triangular, with the outer border arcuate, the upper concave in front straight behind, and the posterior straight, smooth, with scarcely a trace of prominence at the postero-superior angle ; its greatest length  $\frac{7}{8}$  of its depth : second costal largest, tetragonal, with the outside border undulating, the upper feebly convex, and the laterals straight ; the postero-superior angle is somewhat prominent and strongly rugose, the prominence curving downwards to the middle of the lower border as a low wide ridge, the anterior slope of which is much more gentle than the posterior ; the anterior and outer borders have a narrow marginal band of fine striæ, inside which are a few very faint coarser striæ ; its width  $\frac{3}{4}$  of its depth : third costal similar to the second, but with the



prominence more accentuated—though not even here rising above the level of the vertebrae—and the coarser vertical striæ much more pronounced; its width  $\frac{2}{3}$  of its depth: fourth costal pentagonal, owing to the acutely angular point which projects backwards and is inserted for some distance between the fifth vertebral and third marginofemoral shields; the knob is prominent, but small, and is situated some distance below the upper angle; the striæ are moderately developed; its length is  $\frac{2}{3}$  of its depth.

Plastron smooth; gular shields small and triangular; each with the outer border strongly convex, the posterior concave, and the basal width rather less than the length; humeral shield tetragonal, with the outer border feebly, the anterior strongly convex, the posterior irregularly concave, its greatest width  $\frac{2}{3}$  of its length; from the outer front margin of the median vacuity a deep narrow groove extends outwards and backwards, and, crossing the humero-pectoral suture, is lost near the middle of the outer border of the pectoral shield: pectoral shield subtetragonal, the outer border slightly concave, the posterior widely angulated, its greatest width near the posterior border equal to its length on the median line: abdominal shield hexagonal, the anterior and posterior borders concave; inner borders straight, forming together a rectangle, the anterior limb of which is twice as long as the posterior: outer borders also meeting at a right angle, the anterior limb strongly concave and  $1\frac{1}{2}$  times the length of the posterior, which is sigmoidal: width of bridge  $1\frac{1}{4}$  in length of plastron: anterior inframarginal shield half-moon shaped, its length twice its median width: posterior inframarginal much larger, triangular, the anterior border convex, the posterior concave, its greatest width  $\frac{2}{3}$  of its length: femoral shield pentagonal, a little wider anteriorly than long: anal shield acutely triangular, its width  $\frac{2}{3}$  of its length.

Upper surface of fore limbs anteriorly with several series of narrow elongate scale-like plates arranged obliquely; outer edge with three large free foliaceous tubercles, below which are a pair of large flat unguiform plates; lower surface finely reticulate, with scattered scale-like tubercles of various sizes; upper surface posteriorly rugose, with small round tubercles; claws very strong and curved, especially the three inner, the middle one of which is the longest, as long as the space

between the tip of the snout and the posterior border of the orbit. Hind limbs similar, but without the three lateral tubercles, and with an additional stout, horn-like plate at the base of the outer toe.

Tail rugose, with fine vermiculations between; its upper surface with seven stout dermal serræ, which are preceded by two, and succeeded by several finer graduated serræ; sides with isolated scale-like plates; lower surface covered with scales of irregular shape and size.

#### MEASUREMENTS IN MILLIMETRES.

Total length	..	..	..	..	..	860
Length of head mesially	..	..	..	..	..	90
Length of snout	..	..	..	..	..	17
Length of mandibular symphysis	..	..	..	..	..	22
Diameter of eye	..	..	..	..	..	15
Width of interorbital space	..	..	..	..	..	17
Length of neck	..	..	..	..	..	160
Length of fore limb	..	..	..	..	..	110
Length of second claw	..	..	..	..	..	31
Length of hind limb	..	..	..	..	..	115
Length of second claw (the tip broken)	..	..	..	..	..	25
Length of tail	..	..	..	..	..	300
Length of carapace	..	..	..	..	..	330
Width of carapace	..	..	..	..	..	260
Height of body	..	..	..	..	..	133
Length of plastron	..	..	..	..	..	250
Width of plastron	..	..	..	..	..	257
Length of nuchal shield	..	..	..	..	..	40
Width of nuchal shield	..	..	..	..	..	11
Length of margino-nuchal shield	..	..	..	..	..	40
Length of first margino-brachial shield	..	..	..	..	..	40
Length of second margino-brachial shield	..	..	..	..	..	40
Length of first margino-lateral shield	..	..	..	..	..	44
Length of second margino-lateral shield	..	..	..	..	..	42
Length of third margino-lateral shield	..	..	..	..	..	43
Length of fourth margino-lateral shield	..	..	..	..	..	45
Width of fourth margino-lateral shield	..	..	..	..	..	30
Length of fifth margino-lateral shield	..	..	..	..	..	41
Length of first margino-femoral shield	..	..	..	..	..	48
Length of second margino-femoral shield	..	..	..	..	..	47
Length of third margino-femoral shield	..	..	..	..	..	46
Width of third margino-femoral shield	..	..	..	..	..	40
Length of supracaudal shield	..	..	..	..	..	43
Width of supracaudal shield	..	..	..	..	..	32
Length of first vertebral shield	..	..	..	..	..	62
Width of first vertebral shield	..	..	..	..	..	89
Length of second vertebral shield	..	..	..	..	..	70
Width of second vertebral shield	..	..	..	..	..	100

Length of third vertebral shield	..	..	..	..	67
Width of third vertebral shield	..	..	..	..	100.
Length of fourth vertebral shield	..	..	..	..	57
Width of fourth vertebral shield	..	..	..	..	92
Length of fifth vertebral shield	..	..	..	..	74
Width of fifth vertebral shield	..	..	..	..	102
Length of first costal shield	..	..	..	..	95
Width of first costal shield	..	..	..	..	108
Length of second costal shield	..	..	..	..	77
Width of second costal shield	..	..	..	..	130
Length of third costal shield	..	..	..	..	68
Width of third costal shield	..	..	..	..	120
Length of fourth costal shield	..	..	..	..	84
Width of fourth costal shield	..	..	..	..	66
Length of gular shield	..	..	..	..	20
Width of gular shield (along outer border)	..	..	..	..	20
Length of humeral shield	..	..	..	..	55
Width of humeral shield	..	..	..	..	44
Length of pectoral shield	..	..	..	..	62
Width of pectoral shield	..	..	..	..	63
Length of abdominal shield	..	..	..	..	25
Width of abdominal shield	..	..	..	..	73
Length of anterior inframarginal shield	..	..	..	..	25
Length of posterior inframarginal shield	..	..	..	..	45
Length of femoral shield	..	..	..	..	43
Width of femoral shield	..	..	..	..	49.
Length of anal shield	..	..	..	..	81
Width of anal shield	..	..	..	..	31

Fly River, British New Guinea.

Type in the Queensland Museum, Brisbane.

The specimen does not appear to be fully grown since the median plastral vacuities are not so completely ossified as the remaining portion of the plastron.

Nothing whatever is known of the habits of this tortoise, but it may be presumed that they do not materially differ from those of its neogæan relatives.

The surface of the carapace is for the most part covered with a vegetable growth, which has every appearance of a confervoid formation, but I am told that under the microscope it seems rather to be of fungoid origin. The greater part of this growth is very short, but in some places isolated tufts, having a length of from ten to twelve millimetres are to be found. The substance itself is so much dried and shriveled through long exposure to air and light, and a copious use of preservatives, that its determination is a matter of excessive difficulty.

## Family CHELONIIDÆ.

## THE TURTLES.

Shell covered with epidermal shields. Neck incompletely retractile. Limbs paddle-shaped; phalanges without condyles; claws one or two.

All tropical and subtropical seas. Three genera.

In no order of vertebrates, which I can call to mind, has any recent zoölogist ventured to unite in a single genus, a herbivorous with a carnivorous animal; nevertheless this is practically what has been done in the "British Museum Catalogue of Chelonians, etc., 1899," in the case of this important family, where the herbivorous *Testudo mydas* is associated as a congener with the carnivorous *Testudo imbricata*. But beyond the generic separation of these two forms (which is upheld by many high authorities) there lies the question as to whether a complete change is not necessary in the synonymy of two of the three genera. While *Testudo mydas* may be left as the type of *Chelonia* (not *Chelone*) Brongniart\* there can be no shadow of doubt that the claim of *Testudo caretta* to stand as the type of Merrem's genus *Caretta*, to the exclusion of Fitzinger's *Thalassochelys*, can not be ignored, that being the first species described by Merrem under the name *Caretta atra*. It remains, therefore, to determine by what generic title *Testudo imbricata* should henceforth be known, and there is little difficulty in arriving at the conclusion that *Eretmochelys* Fitzinger, must be resuscitated as the earliest available name. The correct titles of the three species of marine turtles, which are included in this family, are, therefore, *Chelonia mydas*, *Eretmochelys imbricata*, and *Caretta caretta*.†

This is a good opportunity of entering my protest against the far too prevalent practice of altering the orthography of an author's name to suit the individual fancy of the writer. It has become quite a common occurrence to find in the writings of certain biological schools violent diatribes directed

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\*I have no access to the work in which Brongniart's genus is founded, and so I cannot speak with certainty as to his actual type.

†The so-called *Thalassochelys* (or *Colpochelys*) *kempi* is now known to be a hybrid between *Chelonia mydas* and *Caretta caretta*. It has been long known to fishermen as the "Bastard Turtle." A pair of young turtles in the Queensland Museum from Keppel Bay have been referred by me to a possible hybrid between *Eretmochelys imbricata* and *Caretta caretta*.

against those authors who honourably adhere to the rule of priority, the justice of which no committee of scientists has ever yet ventured to impugn. They are accused of causing confusion, if, not only in the exercise of their legal right (as laid down in every code of zoölogical nomenclature), but actually in the performance of their bounden duty, they substitute for a name which has been long but erroneously employed a much older but less widely known title. At once from those whose memories are not sufficiently strong to "ring out the false, ring in the true," there comes, from the flurried dove-cotes of sentimentalism, the rallying cry of "confusion," because we refuse, at the entreaty of a school, which fortunately is daily growing smaller in numbers and feebler in authority, to favour the retention of a name which has no claim to existence. But such cases of substitution, which have the imprimatur of the highest authority, are few in number in comparison with the hundreds of names, the orthography of which is annually altered to suit the caprice of irresponsible individuals, on whom, therefore, tenfold lies the onus of accentuating the well-nigh irreparable confusion into which modern nomenclature has drifted.

All such changes, being manifestly illegal, should be sternly deprecated, and, even though already effected, unhesitatingly ignored. If this be permitted in one case, what law is in existence capable of preventing the next author who deals with the same subject dissenting from the orthographic alteration of the preceding writer and substituting a new reading of his own, and so on, and so on, until we have the original spelling multiplied again and again, and the unfortunate student of the future finds himself groping blindly and dizzily in a veritable orthographical maze.

I am not here defending the orthography of the older biologists, which was often erroneous, occasionally eccentric; still, since there was at that time no law against forming a name, according, for instance, to the spelling of the Greek words from which it was derived, no subsequent author is justified in changing the original name, nor can any of our recent laws of zoölogical nomenclature confer such a right.

As a case in point let us take *Kinosternon*. This name was transcribed with absolute accuracy from the Greek characters, and in that form was accepted by such noted

herpetologists as Duméril, Bibron, Bell, and many others ; and I submit that those authors who would change it to *Cinosternum* are acting beyond their rights. By all means, let the current laws be strictly enforced, but at the same time, we must remember, in justice to the great fathers of binomial nomenclature, that those laws, admirable though they be, are not retrospective.

I have now entered my protest against the abuses referred to above, and shall never willingly revert to the subject again. It only remains, therefore, to add that I am fighting against what I regard as a pernicious system, and not against those who, with every justice, think differently to me, some of whom are my personal friends : and because I wish to assist by ever so little in the purification of zoölogical nomenclature from the follies and foibles which are making the noblest study under the sun, the study of Nature, a by-word to the unthinking multitude.

Since writing the above, I have come across a note,\* which, in a most remarkable manner, bears out my contentions as emphasized above, and may be usefully reproduced here. "The law of priority is quite clear in regard to the treatment of such cases,† but some naturalists object to have it enforced on the ground of expediency, and because it would be apt to create confusion. Doubtless, such would be the temporary result in this and all similar instances when errors are corrected which have been continued by writers who have simply followed each other without making independent investigations ; but the confusion is originally caused by those who commit errors, not by those who correct them. . . . It may be inconvenient for those who have become familiar with any special group to have their ideas of its nomenclature disturbed by showing that errors have been committed and then knowingly continued, but that would be a most indefensible reason to advance why these should not be corrected. . . . Conservatism is an excellent principle when it serves as a bulwark against the commission of abuses, but it is a most baneful principle when it is exerted against the correction of errors." *Elliott, Monograph of the Pittidae.*

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\*See "Jordan and Evermann, Fishes of North and Middle America, p. 946."

†That is—the substitution of a correct but hitherto ignored name for an erroneous but commonly accepted one.

I look upon this energetic expression of opinion, from the pen of a distinguished author, as a complete vindication of the attitude which I have taken up on this highly important question, which intimately affects the future well being of biological science.

- a. Carapace with persistent fontanelles between the costal and marginal plates; marginal shields twenty-five; four pair of costal shields; head small.
- b. Posterior margin of carapace smooth or nearly so; jaws not hooked; one pair of prefrontal shields .. .. i. *Chelonia*.
- bb. Posterior margin of carapace serrated; jaws hooked; two pairs of prefrontal shields .. .. ii, *Eretmochelys*.
- aa. Carapace completely ossified in the adult; marginal shields usually twenty-seven; five or more pair of costal shields; head large .. .. iii. *Caretta*.

### Genus III., CHELONIA.

*Chelonia*, Brongniart, Bull. Soc. Philom., ii. 1800, p. 89 (*mydas*); Gray, Catal. Tort., p. 54, 1844.

*Euchelys*, Girard, U.S. Explor. Exped., Herp. p. 447, 1858 (*macropus*=*mydas*).

*Chelone*, Strauch, Chelon. Stud., p. 59, 1862 (*mydas*); Boulenger, Catal. Chelon., p. 180, 1889.

Carapace with persistent fontanelles between the costal and marginal plates, its posterior border smooth or indistinctly serrated; marginal shields twenty-five; costal shields in four pair; intergular shield present, well developed. Head small; jaws not hooked; symphysis of lower jaw short; one pair of prefrontal shields. Herbivorous (*χελώνη*, a tortoise).

All tropical and subtropical seas. Monotypic.

### 3. CHELONIA MYDAS.

*Testudo mydas*, Linnæus, Syst. Nat., i. p. 350, 1766.

*Chelonia mydas*, Schweigger, Prodr., p. 22, 1814.

*Chelonia marmorata*, Duméril & Ribron, Erpét. Gen., ii. p. 546, pl. xxiii. fig. 1, 1835, Ascension.

*Chelone mydas*, Boulenger, Catal. Chelon., p. 180, 1889.

### THE GREEN TURTLE.

Carapace feebly unicarinate in the young, arched or subtectiform in the adult; dorsal shields juxtaposed. Horny sheaths of lower jaw with strongly denticulated edge. Limbs usually with a single claw. Olive or brown, spotted or marbled with yellowish.

Length of carapace to  $3\frac{1}{2}$  feet.

Distribution as in the genus.

The food of the edible turtle consists entirely of seaweeds.

#### Genus IV., ERETMOCHELYS.

*Eretmochelys*, (Fitzinger) Agassiz, Contr. Nat. Hist. U.S., i. p. 380, 1857 (*imbricata*).

*Onychochelys*, Gray, Proc. Zool. Soc., 1873, p. 397 (*kraussi*=*imbricata*).

Carapace with persistent fontanelles between the costal and marginal plates, its margin serrated posteriorly; marginal shields twenty-five; four pair of costal shields; intergular shield present, well developed. Head small; jaws hooked; symphysis of lower jaw long; two pairs of prefrontal shields. Carnivorous (*ἑρπετός*, an oar, *χέλυς*, a tortoise).

All tropical and subtropical seas. Monotypic.

#### ERETMOCHELYS IMBRICATA.

*Testudo imbricata*, Linnaeus, Syst. Nat., i. p. 350, 1766.

*Chelonia imbricata*, Schweigger, Prodr., p. 21, 1814; Duméril & Bibron, Erpét. Gen., ii. p. 548, pls. ii & xxiii. fig. 2, 1835.

*Eretmochelys imbricata*, Agassiz, Contr. Nat. Hist. U.S., i. p. 381, 1857.

*Chelone imbricata*, Boulenger, Catal. Chelon., p. 183, 1889.

#### THE HAWKSBILL TURTLE.

Carapace tricarinate in the young, with the shields strongly imbricate, the vertebrals rhomboidal; dorsal shields of adult smooth, of old specimens juxtaposed. Edges of jaws not or but feebly denticulated. Limbs with two claws. Carapace marbled with yellow and dark brown; posterior yellow; shields of head and limbs dark brown, with yellow borders. (*imbricata*, overlapping; in allusion to the dorsal shields of the young).

Length of carapace to 3 feet.

The Hawksbill Turtle, from which the so-called tortoise shell of commerce is derived, is wholly carnivorous.

#### Genus V. CARETTA.

*Caretta*, Merrem, Tent., p. 17, 1820 (*atra*=*caretta*).

*Thalassochelys*, Fitzinger, Ann. Wien. Mus., i. 1835, p. 121; Boulenger, Catal. Chelon., p. 184, 1889.

*Caouana*, Gray, Catal. Tort., p. 52, 1844 (*caretta*).

Carapace completely ossified in the adult, its margin formed of twenty-seven, rarely twenty-five shields. Costal shields in five or more pairs; intergular shield very small or



absent. Head large, the jaws hooked; symphysis of the lower jaw very long. Two pair of prefrontal shields. Carnivorous. (*Caretta*, a turtle).

All tropical and subtropical seas.

#### 5. CARETTA CARETTA.

*Testudo caretta*, Linnæus, Syst. Nat., i. p. 351, 1766.

*Chelonia dussumieri*, Duméril & Bibron, Erpét. Gen., ii. p. 557, pl. xxiv. fig. 1, 1835.

*Thalassochelys caretta*, Boulenger, Catal. Chelon., p. 184, 1889.

#### THE LOGGERHEAD TURTLE.

Carapace strongly tricarinate in the young, arched or subtectiform in the adult; serrated posteriorly in the young. Jaws very strong. Limbs of young usually with but two claws, of adult often with but one. Brown above, yellowish below.

Length of carapace to  $3\frac{1}{2}$  feet.

The Loggerhead feeds principally on mollusks and crustaceans. Outside of the ordinary limits of its distribution it has been captured on the south coast of England (Devonshire), the west coast of France (Vendée), and the Dutch coast. An example was also washed ashore dead on the island of Vallay, North Uist, Scotland, in 1889.

#### Superfamily $\beta$ . PLEURODIRA.

Neck bending laterally. Pelvis ankylosed to the carapace and plastron. Digits with not more than three phalanges. A complete series of marginal bones connected with the ribs. (πλευρά, side; δειρή, neck.)

#### Family D. CHELYIDÆ.

#### THE SIDE-NECKED TORTOISES.

Shell covered with epidermal shields. Neck bending under the margin of the carapace, always exposed. Digits moderately elongate; claws four or five. (χέλως, gen.; χέλως, a tortoise.)

Fresh waters of Australia, New Guinea, and South America. Genera nine.

- a. Intergular shield large, separated from the margin by the gulars; neck longer than the vertebral column; symphysis of lower jaw narrow . . . . . i. *Chelodina*.
- aa. Intergular shield moderate, marginal; neck shorter than the vertebral column; symphysis of lower jaw wide . . . . . ii. *Emydura*.

## Genus VI. CHELODINA.

## THE LONG-NECKED RIVER TORTOISES.

*Chelodina*, Fitzinger, N. Class. Rept., p. 6, 1826 (*longicollis*) ; Gray, Syn. Rept., p. 38, 1831 ; Boulenger, Catal. Chelon., p. 213, 1889.

Nuchal shield present, marginal ; first vertebral shield the largest ; intergular shield large, situated behind the gulars, between the humerals and pectorals. Neck longer than the dorsal vertebral column. Jaws weak without alveolar ridges ; symphysis of lower jaw narrow. No dermal appendages on the chin. (χελυς, a tortoise ; δεινός, strange.)

Australia ; New Guinea ; Rotti. Species five.

## 6. CHELODINA NOVÆ-GUINÆÆ.

*Chelodina novæ-guinææ*, Boulenger, Ann. Mus. Genov., (2) vi. 1888, p. 450, Katow, and Catal. Chelon., p. 215, pls. v and vi, 1889.

## THE NEW GUINEA LONG-NECKED TORTOISE.

Carapace much depressed, oval, broadest behind ; the adult with a vertebral groove and ornamented with vermicular rugosities ; nuchal shield large, considerably longer than wide ; first vertebral shield the largest, last the smallest. Front lobe of plastron narrower than the carapace ; intergular shield three times as long as the suture between the pectorals ; suture between the anals about twice as long as that between the femorals. Chestnut-brown above ; brownish-yellow below.

Length of carapace to  $5\frac{1}{2}$  inches ; probably growing to a considerably larger size.

South-eastern New Guinea ; Island of Rotti, near Timor (Lidth de Jeude).

## 7. CHELODINA SIEBENROCKI.

*Chelodina siebenrocki*, Werner, Verh. Ges. Wien, li. 1901, p. 602, pl. v, New Guinea.

The above, extracted from the Zoölogical Record for 1901 (Rept. and Batr., p. 28), is the sum of the information of which I am possessed regarding this species.

It is much to be regretted that foreign authors, when writing on Australian subjects, do not see their way to sending copies of their papers to the various societies and museums of Australasia, and by this simple means averting the inevitable confusion which must occur by the redescription of their genera and species. Such an act of thoughtfulness would be greatly appreciated by their fellow workers here.

As an illustration of the evil effects which may, and in fact do, follow this omission, I may be permitted to point out that if a *Chelodina*, otherwise than *C. novæ-guinææ*, should be received by me from any part of Papua, I should feel myself justified in ignoring Herr Werner's species and describing mine as new; and the confusion, if any should arise, would lie at the door of the Austrian author not at mine (see Appendix, p. 30).

Some twenty years ago the late Sir William Macleay made a similar appeal for consideration to continental authors, but apparently it was of no avail.

In the same category as *Chelodina siebenrocki* would *Pseudemydura umbrina*\* have had to be placed, so far as its author is concerned, but fortunately Dr. Steindachner, with whom I had communicated in references to these two species, sent me a copy of the description. My best thanks are due to this gentleman for his promptitude in answering my appeal. I am sure that it is only necessary to call attention to the above omission in order to have it remedied.

## Genus VII. EMYDURA.

### THE MUD TORTOISES.

*Emydura*, Bonaparte, Arch. f. Nat., i. 1838, p. 140 (*macquarii*); Boulenger, Catal. Chelon., p. 228, 1889.

*Chelymys*, Gray, Catal. Tort., p. 42, 1844 (*macquarii*=*australis*).

*Euchelymys*, Gray, Ann. & Mag. Nat. Hist., (5) viii. 1871, p. 118 (*sulcifera*=*macquarii*).

Nuchal shield present or absent, marginal; second vertebral shield as large as or larger than the first; intergular shield moderate, marginal, situated between the gulars and humerals. Neck shorter than the dorsal vertebral column. Alveolar surface of upper jaw without median ridge; symphysis of lower jaw wide. Chin with or without dermal appendages. (ἐμύς, a fresh-water tortoise; ὄψα, tail).

Australia and New Guinea. Species seven.

- a. Upper surface of neck with small rounded tubercles.
- b. Width of bridge less than one third of the length of the plastron; nuchal shield present.
- c. Plastron subtruncate or rounded anteriorly: barbels present, small .. .. . i. *macquarii*.
- cc. Plastron obtusely acuminate anteriorly; barbels absent .. .. . 2. *albertisii*.

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\**Pseudemydura umbrina*, Siebenrock, Anz. Ak. Wien, 1901, No. xxii.

- bb. Width of bridge one third or more than one third of the length of the plastron; nuchal shield present or absent . . . . . 3. *subglobosa*.
- aa. Upper surface of neck with conical erect tubercles.
- d. Nuchal shield present; intergular shield thrice as long as wide . . . . . 4. *novæ-guinææ*.

## 8. EMYDURA MACQUARIAE.

*Hydraspis macquarii*, Gray, Synops. Rept., p. 40, 1831, Macquarie River.

*Chelymys victoriae*, part., Gray, Proc. Zoöl. Soc., 1872, p. 506, pl. xxvii, Victoria River.

*Chelymys macquaria*, McCoy, Prodr. Zoöl. Vict., dec. 9, pls. lxxxii and lxxxiii, 1884.

*Emydura macquariae*, Boulenger, Catal. Chelon., p. 230, 1889.

## THE MACQUARIE MUD TORTOISE.

Carapace more or less depressed, greatly expanded but not or only feebly serrated posteriorly, ornamented with longitudinal or sinuous rugosities or vermiform impressions, and bearing a more or less distinct linear vertebral groove. Intergular shield not twice as long as wide, larger than the gulars. A pair of small mental barbels. Carapace olive or olive-brown; plastron pale olive or yellowish green; soft parts dark brown or olive; a yellow band from the angle of the mouth along the side of the neck, passing across the lower border of the ear. (Named for Colonel Lachlan Macquarie, seventh Governor of New South Wales).

Length of carapace to 12 inches.

South-eastern Australia; north-western Australia (Victoria River); southern New Guinea (Fly River).

Type of *Chelymys victoriae* in the South Kensington Museum.

Dr. J. E. Gray, in his synonymy of this tortoise (Proc. Zoöl. Soc., 1872, p. 506), quotes as its earliest name "*Emys macquaria*, Cuvier, Règne Anim., ii. p. 11"; in this he is followed by McCoy. Boulenger, however, omits all mention of Cuvier's name, and I have, therefore, employed Gray's original orthography (less the unnecessary additional "r" as written by himself. *Emys macquaria* is probably a *nomen nudum*, and as such must be ignored.

## 9. EMYDURA ALBERTISII.

*Emydura albertisii*, Boulenger, Ann. Mus. Genov., (2) vi. 1888, pp. 449 and 451, Katow; and Catal. Chelon., p. 232 1889.

## D'ALBERTIS' MUD TORTOISE.

Carapace more or less depressed, not or but feebly serrated posteriorly, obtusely keeled in the male, convex and very rugose in the female. Intergular shield nearly twice as long as wide, as wide as or narrower than the gulars. Carapace blackish brown; plastron bright yellow; an olive band on the bridge, bordered on each side by a more or less distinct festooned brown band; soft parts dark brown; a bright yellow band from the nostrils to above the ear, passing on the upper eyelid; a yellow band on the upper jaw and another on the lower. (Named for Signor L. M. D'Albertis, Italian explorer and biologist).

Length of carapace in the larger type to  $6\frac{1}{2}$  inches; probably growing considerably larger.

South-eastern New Guinea (Katow).

Types in the Genoa Museum of Natural History.

Two specimens, a male and a female, only are known; they were collected by Signor D'Albertis.

## 10. EMYDURA SUBGLOBOSA.

*Euchelymys subglobosa*, Krefft, Ann. Mus. Genov., viii. 1876, p. 390, Naiahui; Peters and Doria, Ann. Mus. Genov., xiii. 1878, p. 328.

*Emydura subglobosa*, Boulenger, Ann. Mus. Genov., (2) vi. 1888, p. 450; and Catal. Chelon., p. 232, 1889.

## HUMP-BACKED MUD TORTOISE.

Carapace very convex, not or but feebly serrated posteriorly, rugose, with a linear vertebral groove; intergular shield large, a little longer than wide, much larger than the gulars. Carapace brown; plastron yellow; soft parts brown; a yellow band from the end of the snout to above the ear, passing through the eye; a yellow band on the upper jaw and another on the lower. (*Subglobosa*, nearly spherical.)

Length of carapace to  $9\frac{1}{2}$  inches.

South-eastern New Guinea.

Type in the Genoa Museum of Natural History; collected by D'Albertis on the Amama River.

The Queensland Museum possesses a fine pair of this tortoise, presented by Anthony Musgrave, Esq., who obtained them in the vicinity of Port Moresby. In one of these the nuchal shield is present, in the other absent.

#### 11. EMYDURA NOVÆ-GUINÆÆ.

*Platemys novæ-guinææ*. Meyer, Mon. Berl. Ac., 1874, p. 128, Passim.

*Emydura novæ-guinææ*, Boulenger, Ann. Mus. Genov., (2) vi. 1888, p. 450; and Catal. Chelon., p. 233, 1889.

#### BLACK-SPOTTED MUD TORTOISE.

Carapace depressed, serrated posteriorly, keeled, and slightly rugose. Intergular shield very narrow, thrice as long as wide, much smaller than the gulars. Carapace brown; plastron yellowish; soft parts brown; a small blackish spot on each vertebral and costal shield.

Length of carapace in type 5 3-5 inches.

New Guinea (Passim, Meyer; Katow, D'Albertain).

#### Superfamily γ. TRIONYCHOIDEA.

#### THE SOFT-SHELL TORTOISES.

Neck bending by a sigmoid curve in a vertical plane. Pelvis not ankylosed to the carapace and plastron. Fourth digit with four or more phalanges. Marginal bones absent or forming an incomplete series, not connected with the ribs.

(*Trionyx* — from *τρεῖς*, three and *ὄνξ*, gen *ὄνυχος*, a claw—the typical genus; *ἴδιος*, resemblance.)

#### Family E. CARETTOCHELYIDÆ.

#### THE TURTLE TORTOISES.

Shell without epidermal shields. Neck not retractile. Limbs paddle-shaped; digits much elongate; only the inner two clawed.

Monotypic.

In the British Museum Catalogue of Chelonians (1889) this family is placed at the end of the *Pleurodira* and therefore next to the *Trionychoidea*. In the following year, however, Dr. Baur (American Naturalist, xxiii, 1890, p. 1017) expressed his doubts as to the correctness of this position; and subsequently (op. cit., xxv, 1891, pp. 631, 639, and Science, xvii, 1891, p. 190) gave it as his opinion that the *Carettochelyidæ* were probably very close to the ancestors of the *Trionychoidea*. From an examination of the photographs of the

skull he considers (Science, loc. cit.) *Carettochelys* to be "an ancestral form of the *Trionychia*, which still preserves the peripheral bones, and which has the carapace and plastron completely closed." He concludes—" *Carettochelys* cannot be placed in any group of living tortoises; it has to be considered as the representative of a peculiar group ancestral to the *Trionychia*, and in relation probably to the *Amphichelydia*. This group I propose to call *Carettochelydes*."

Nothing further was learnt about this species until 1898 (Proc. Zool. Soc., p. 851), when Boulenger exhibited, at a meeting of the London Zoological Society, a dancing-stick from Dameracura, mouth of the Fly River, New Guinea, to which two imperfect skulls of *Carettochelys* were attached as ornaments or charms. As Boulenger considered that these "specimens confirmed the account given by Baur in 1891" I have removed the family from the *Pleurodira* and placed it among the *Trionychoidea*.

The above is all that is known of this remarkable tortoise, and in view of the extraordinary interest which attaches to it, it is to be hoped that the naturalists of New Guinea will shortly find means to collect other specimens both of adults and young, and put us in possession of some authentic data both as to its habits and mode of life.

#### Genus VII. CARETTOCHELYS.

*Carettochelys*, Ramsay, Proc. Linn. Soc. N.S. Wales, xi. 1886, p. 158 (*insculpta*); Boulenger, Catal. Chelon., p. 236, 1889.

"Six neural plates, all separated from one another by the costals, which meet on the median line"—Boulenger. (*Caretta*, a turtle; χέλυς, a tortoise.)

New Guinea.

#### 12. CARETTOCHELYS INSCULPTA.

*Carettochelys insculptus*, Ramsay, Proc. Linn. Soc. N.S. Wales, xi. 1886, p. 158, pls. iii-vi, Fly River.

*Carettochelys insculpta*, Boulenger, Catal. Chelon, p. 236, 1889.

#### THE FLY RIVER TORTOISE.

"Carapace subcordiform, elevated and rounded in front, laterally flattened behind and strongly keeled, sides shelving, with the marginal plates expanding, densely rugose. Twenty-one marginals (including the pygo-marginal). The whole of the plates of the carapace and plastron are covered with small, round, raised rugations or wavy irregular raised

lines between shallow sculptures ; towards the lower borders on the sides these take an elongated form sometimes parallel to the sutures. Head large, with five to seven shields, the anterior and median pairs coalesced, lower jaw strong. Anterior margin of forelegs covered with from seven to ten narrow, band-like, unequal shields. Tail short, with from fourteen to sixteen narrow curved shields on the upper surface"—Boulenger. (*insculpta*, engraved.)

Length of carapace 18 inches.

Fly River.

Type in the Australian Museum, Sydney.

#### Family F. TRIONYCHIDÆ.

#### THE ELEPHANT TORTOISES.

Shell without epidermal shields. Jaws concealed under fleshy lips ; snout ending in a proboscis. Head and neck completely retractile. Ear hidden. Only the three inner digits clawed.—Boulenger. (*τρι*, three ; *ὄνυξ*, a claw.)

Rivers of Africa, Asia, New Guinea, and North America.

#### Genus VIII. PELOCHELYS.

*Pelochelys*, Gray, Proc. Zool. Soc., 1864, p. 89 (*cantorii*) ; Boulenger, Catal. Chelon., p. 262, 1889.

Jaws weak. Orbit nearer the nasal than the temporal fossa ; bony choanæ between the orbits ; postorbital arch as wide as the diameter of the orbit. (*πηλός*, clay, mud ; *χέλυσ*, a tortoise.)

Eastern India to New Guinea.

#### 13. PELOCHELYS CANTORII.

*Chitra indica*, part., Gray, Catal. Tort., p. 49, 1844 ; Günther, Pept. Brit. Ind., p. 59, pl. vi. 1896 ; fig. C, 1864.

*Gymnopus indicus*, Cantor, Catal. Malay, Rept., p. 10, 1847.

*Pelochelys cantorii*, Gray, Proc. Zool. Soc. 1864, p. 90, Malacca ; Lydekker, Roy. Nat. Hist., v. p. 100, fig., 1896.

*Pelochelys cantoris*, Boulenger, Catal. Chelon., p. 263, 1889 ; Waite, Rec. Austr. Mus. v. 1903, p. 50.

#### CANTOR'S SOFT-SHELL TORTOISE.

Costal plates in eight pairs, the last well developed and forming a median suture ; a single neural between the first pair of costals ; plates coarsely pitted and vermiculate. Head moderate ; snout short and broad ; proboscis very short ; interorbital space broader than the greatest diameter of the



orbit; mandible narrowest at the symphysis.. Olive above, uniform or spotted with darker.

Length of carapace 24 inches.

Laloki River, B.N.G.; Philippines; Borneo; Malay Peninsula; Burma; Ganges.

Type in the South Kensington Museum.

#### APPENDIX.

On an earlier page of the present paper I referred to the species described below, and remarked that I only knew of its existence through the medium of the "Zoölogical Record" for 1901; since then, I have, however, received a complimentary copy of the paper in which it is described, from its author, to whom I take this opportunity of returning my grateful thanks. By his courtesy I am not only able to add to the description of this new species, but also to add *Emydura Krefftii* to the fauna, and so complete the list of New Guinea chelonians to date. Appended is a translation of Dr. Werner's original description.

#### CHELODINA SIEBENROCKI.

*Chelodina siebenrocki*, Werner, Verh. zool.-bot. Ges. Wien, 1901, p. 602, Dutch New Guinea.

Intergular shield  $1\frac{1}{2}$  time as long as the suture between the pectorals, twice as long as wide. Plastron somewhat less than twice as long as wide. Pectoral shields much longer than any single median suture of the plastron,  $1\frac{1}{2}$  time as long as the femoral suture, and  $2\frac{1}{3}$  times as long as that of the abdominals; anal suture somewhat shorter than the femoral shield. Head very long, nearly twice as long as wide, little shorter than half of the plastron. Skin behind the eyes tessellated, but smooth along the median line, the spaces mostly longer than wide. Lower jaw, especially at the symphysis, much more feeble than in *Chelodina novæ-guinææ*, only one third as wide as the diameter of the eye; on one side two very small barbels are present. Seven or eight wide, band-like lamellæ on the front of each fore leg. Above black, below dark brown. Hinder costal and vertebral shields longitudinally striated nearly to the border of the carapace. Nuchal shield rectangular,  $1\frac{1}{2}$  time longer than wide. First vertebral shield the largest, fifth the smallest, six present, as in *Chelodina novæ-guinææ*. (Named for Dr. Friedrich Siebenrock).

## MEASUREMENTS IN MILLIMETERS.

Width of carapace	..	..	..	..	..	160
Length of plastron	..	..	..	..	..	165
Width of plastron	..	..	..	..	..	85
Length of head	..	..	..	..	..	78
Width of head	..	..	..	..	..	43

In addition to the shortness of the symphysis of the lower jaw referred to by Dr. Werner, it should be noted that while in *Chelodina novæ-guinæ* the intergular shield is three times as long as the suture between the pectoral shields, in this species it is only  $1\frac{1}{2}$  time as long as the same.

## 8a. EMYDURA KREFFTII.

*Chelymys krefftii*, Gray, Ann. & Mag. Nat. Hist., (5) viii. 1871, p. 366, Burnett River, Queensland, and Proc. Zool. Soc., 1872, p. 506. pl. xxviii.

*Chelymys victoriae*, part., Gray, Proc. Zool. Soc., 1872, p. 506, fig. 2 (woodcut on p. 507).

*Emydura krefftii*, Boulenger, Catal. Chelon., p. 230, 1889; Werner, Verh. Zool.-bot. Ges. Wien, 1901, p. 603.

## KREFFT'S MUD TORTOISE.

Carapace more or less depressed, the depth of the shell  $2\frac{3}{5}$  to 3 in its length, little expanded and not or but feebly serrated posteriorly, the sculpture and vertebral groove similar to that of *Emydura macquarii*, as also are the shape and size of the intergular shield. No mental barbels. Carapace olive or olive brown, plastron yellowish green; a yellow band from the eye to the ear. (Named for Gerald Krefft, then Curator of the Australian Museum, Sydney).

Length to 10 inches.

Queensland; Dutch New Guinea.

Type in the South Kensington Museum.



# ON TRYPANOSOMA AND THEIR PRESENCE IN THE BLOOD OF BRISBANE RATS.

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**By C. J. POUND, F.R.M.S.**

(Govt. Bacteriologist)

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(Read before the Royal Society of Queensland, 3rd Sept., 1904)

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DURING the past four years I have examined large numbers of rats of different species for plague, and occasionally in the systemic blood of some of the rats I detected the presence of those peculiarly interesting micro-parasites, the Trypanosomas. These organisms were first discovered by T. R. Lewis in India in 1879. He describes them as occurring in the blood of rats and hamsters which were apparently healthy. At first he thought they were spirilla, but on closer examination he found they possessed a distinct body outline, with at one end a flagellum. Lewis's original drawings of these organisms, which appear in the *Quarterly Journal of Microscopical Science* for that year, are somewhat primitive, compared with the same organisms seen with present day instruments. Lewis depicts them as having cylindrical or bi-tapering bodies, one end of which continued into a long lash-like thread. They were detected in twenty-nine per cent. of the species of rats *Mus decumanus* and *Mus rufescens*, and although from their movements and general appearance they resembled organisms of bacterial origin, Lewis considered they were more closely related to the Protozoa.

In 1880, Dr. G. Evans, of the Army Veterinary Department in India, discovered the presence of a Trypanosoma

parasite in the blood of horses, mules and camels which were suffering from a disease known as Surra, and which was extremely fatal to these animals in the Punjaub and British Brumah. In 1885, Veterinary Surgeon Steele further investigated the same disease and found the parasites in all cases, moreover both Evans and Steele proved by numerous experiments, that by means of subcutaneous inoculation and by the introduction into the stomach of blood containing the parasites the disease was transmitted to healthy animals. In 1882 Certes demonstrated the presence of Trypanosomas in body fluids of certain oysters. In 1883 micro-organisms similar to those found in the rat were observed by Mitrophanow as occurring in the blood of mud fish and the German carp.

In 1885 B. Danilewsky discovered Trypanosoma in the blood of birds, including ducks, geese, and fowls.

In 1886 Professor E. M. Crookshank very materially added to our knowledge of these organisms by investigating the morphology and life history of the Trypanosoma which he discovered in about 25 per cent. of the London sewer rats, and in the following year he succeeded in producing some excellent photo-micrographs, which clearly showed the presence of the flagellum, the dorsal undulating membrane, and the pulsating vacuole. In 1895 Dr. David Bruce announced the very important discovery that the tsetse fly disease, or Nagana, in Zululand was caused by a Trypanosoma. For over three years Bruce very closely studied the disease and conducted a series of interesting investigations, in which he not only brought to light many new morphological characters of the organism, but demonstrated its presence in the blood of horses, mules, asses, cattle, buffaloes, antelopes, camels, hyenas, and dogs; moreover from all these animals the organisms were transmissible to such experimental animals as the cat, rat, mouse, rabbit, hedgehog, donkey, bosch-bok, hybrid of zebra, guinea pig, goat, sheep, monkey, and weasel. He also proved that under natural conditions, the disease was transmitted from animal to animal solely by the tsetse fly (*Glossina moritans*).

After Bruce's researches the subject of Trypanosomiasis was taken up and studied in various parts of the world, but

more particularly tropical countries, by many competent observers, notably Laveran, Koch, Lingard, Plimmer, Bradford, Theiler, Allen Smith, Voges, and Vsigburg.

The combined labours of these investigators have confirmed the researches of the more early workers on the subject, and have published much valuable information concerning the life history of the different species of *Trypanosoma*, technique of the methods for the detection, influence of sex, age and breed of the many species of animals that are subject to Trypanosomiasis, and also the questions of treatment of the disease and immunity.

In 1902 considerable interest was aroused in the medical profession by what may be taken to be a newly discovered disease in the human subject, for Dr. J. E. Dutton, of the School of Tropical Medicine in Liverpool, demonstrated the trypanosoma parasites in the blood of a man who had been living in the Gambia colony on the West Coast of Africa. Dutton mentions in his report that this patient was first seen by Dr. Forde in the Gambia colony in May, 1901, and in his blood he found small worm-like extremely active parasites, which was subsequently recognised by Dutton as trypanosoma. The symptoms presented by the patient were: Irregularly intermittent febrile attacks, the temperature remaining above normal (2 or 3 degrees) for a few days, and then falling below normal for a few days; the skin dry, with irregular patches of a congested or cyanosed character; puffy oedema of the face, and slightly around and above the ankles, respirations and pulse altered, being rapid and variable; heart sounds peculiarly muffled; urine and bowel excretions practically normal. In the later stages of the complaint both liver and spleen were found enlarged. Loss of weight and considerable debility, wasting, and lassitude were marked during the progress of the case. Dutton also found the parasite in the blood of a child, three years old, a native of the Gambia, but in whom no symptoms of illness were present. A little later Manson met with a patient in London whose symptoms were so suspicious that on examining his blood trypanosomas were detected, and thereby a significant advance in the clinical recognition of the disease was made.

Coming to a still more recent date, Aldo Castellani, in June, 1903, discovered an entirely new form of trypanosoma in the blood and cerebro-spinal fluid of patients suffering from sleeping sickness in Uganda on the shores of the lake Victoria Nyanza, in Central Africa.

So far in Queensland and possibly Australia Trypanosoma have only been demonstrated in the blood of rats, but I have proved their existence in at least three distinct species, viz., *mus decumanus*, the common brown rat; *mus rattus*, the old English black rat, which has very large, thin round ears, and a somewhat long, tapering tail; and *mus Alexandrinus rufus*, which is probably a hybrid between the brown and the black rat possessing all the morphological characters of the latter, but having a reddish-brown coat.

My observations are confirmatory of Crookshank's, in that rats having these parasites in their blood are apparently healthy.

#### EXAMINATION OF FRESH AND STAINED SPECIMENS.

If a drop of blood from a surra rat be examined under the microscope with  $\frac{1}{2}$  objective it appears to quiver with life, and even with an oil immersion lense the parasites are extremely difficult to examine until their movement is arrested for a moment or they are imprisoned in the serum areas. As they are so actively motile they form very fascinating objects for the microscopist. A single organism will lash its flagellum in all directions as though endeavouring to free itself from its environment of red and white blood corpuscles. The body readily twists upon itself or from side to side with great activity. It can turn completely round with lightning rapidity, so that the flagellum will be lashing the blood cells for a moment in one direction, and then suddenly lash them in the opposite direction.

Sometimes it will spin round on its long axis and then at an incline on its short axis. Occasionally it appears as if attached by means of the spine-like process to a corpuscle, remaining stationary or lashing its flagellum. At first sight they appear to wriggle along either backwards or forwards, but the general mode of progression is by means of the fla-

gellum threading its way between the corpuscles, drawing the body of the organism after it, thus, as Crookshank states, the flagellum acts as a tractellum and not as a pulsellum. This feature of the movement of the flagellum in front drawing the body of the organism behind is almost a distinct peculiarity of such low types of animal life as the Protozoa.

All the trypanosoma are decidedly polymorphic, but as a rule they have slightly tapering bodies which terminate at one end with a stiff acutely pointed process, while the opposite end is provided with a long flagellum, which is a really a continuation of a delicate fin-like membrane attached to nearly two-thirds of the back of the organism. When carefully examined under a critical high power objective, the body substance is seen in parts to be distinctly granular and possessed of two or more highly refractive spherules; the one in the centre of the body being the nucleus, while at the posterior end there are usually two, one of which is the centrosome, and the other the pulsating vacuole.

The average size of the body of a trypanosoma is about 20 to 30 micro-millimetres long, and from 0.8 to 1 micro-millimetres broad; while the flagellum is about as long as the body, so that the total length of the organisms would be about 50 micro-millimetres, in fact many of them are in length from six to eight times the diameter of a red blood corpuscle, or roughly speaking the  $\frac{1}{300}$  of an inch.

Notwithstanding that trypanosoma may be detected in the blood in the living condition it is a very distinct advantage to be able to examine them after they have been fixed and stained and permanently mounted.

For this purpose I have been extremely successful in staining them with methylene blue, gentian violet, and Bismarck brown, in either of which watery solutions the coverglass smears after fixing with absolute alcohol should be left for at least from 12 to 24 hours; they are then washed in water and mounted in Xylol Balsam. One of the best and most permanent stains I find is carbol fuchsin; a little of this stain is placed in a watch glass, and the green metallic looking scum removed by the addition of two or three drops of alcohol. The coverglass smear is then floated, prepared



side down, and the whole gently heated over a spirit lamp or bunsen flame until the steam rises, when the green scum is about to make its re-appearance, remove the coverglass with a pair of forceps, wash in water and afterwards in very dilute alcohol; finally dry and mount in Xylol Balsam. In specimens so prepared all the morphological characters of the organisms are very clearly demonstrated. As to their permanency I have some preparations which I made in 1886 in London and which still show all the peculiar features of this organism.

The above stains are admirably adapted for photomicrographic purposes, but for studying the structure of such delicate organisms I find the recently introduced blood staining methods of Romanowsky, Leishman and Jenner to give the most satisfactory results. By either of these methods, in which eosin and methylene blue dissolved in pure methyl alcohol are employed, different parts of the organism have an affinity for selecting in varying degrees one or other of the combined stains.

Of the three methods I prefer Romanowsky's: the blood to be examined is spread in a very thin film on a cover-glass, and allowed to dry spontaneously, which is sufficient to fix the specimen without passing through the flame, allow a few drops of stain to remain on the film for five minutes, then add an equal quantity of freshly distilled water, mixing gently for another three minutes, wash thoroughly in distilled water, dry in the air, and mount in xylol balsam.

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# A PRELIMINARY REVISION OF THE AUSTRALIAN THYRIDIDAE AND PYRALIDAE.

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## PART II.

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**By A. JEFFERIS TURNER, M.D., F.E.S.**

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*(Read at Annual Meeting, 28th January, 1905)*

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THE present contribution consists of new genera and species, additional localities, and notes on the synonymy of the groups treated of in Part I. The new species have come into my hands since I examined the British Museum types, and I am much indebted to Sir George Hampson, who has examined most of them, not only comparing or identifying them with described species, but advising me as to their generic location. Though I have not felt bound to follow his advice in every instance, it has been of the greatest assistance. To him I am also indebted for a number of references which I was not able to give last year. The following of Sir George Hampson's names were unpublished last October :—

Anerastria metamelanella	Chilostrigatellus
Eucallionyma mediozonalis	Platytes latifasciella
Balaenifrons haematographa	Talis brunnea
Balaenifrons phoenicozona	Endotricha lobibasilis
Gen. Galleristhenia	Vitessa glaucoptera
Galleristhenia mellonidiella	Orthaga rubridiscalis
Crambus medioradellus	

### FAM. THYRIDIDAE.

#### HYPOLAMPRUS MARGINEPUNCTALIS.

*Microsca marginepunctalis*, Leech, Entom, 1889., p. 66.,  
Pl. IV., f. 10.

## HYPOLAMPRUS SUBROSEALIS.

*Microsca subrosealis*, Leech, Entom, 1889., p. 66, Pl. IV., f. 14.

*Hypolamprus subrosealis*, Hmps., Moths Ind. i., p. 366.

N. Q., Thursday Island. Also from Borneo, China, Ceylon and India.

## †† HYPOLAMPRUS LEOPARDATUS.

*Hypolamprus leopardata*, Warr., Nov. Zool. 1897. p. 380.

N.Q., Cooktown.

## RHODONEURA SCITARIA.

N.Q., Kuranda.

## RHODONEURA SEMITESSELLATA.

*Pyralis ? semitessellalis*, Wlk., Brit. Mus. Cat. xxxiv., p. 1246.

*Striglina hyalospila*, Low., Tr. R.S.S.A., 1894, p. 87.

I take this synonymy from Mr. Warren (Nov. Zool. 1898, p. 223), who has examined Lower's type. No doubt this species is variable, like others of the genus.

N.Q., Townsville.

## RHODONEURA THEORINA.

N.Q., Cairns.

## RHODONEURA DISSIMULANS.

Q., Stradbroke Island, in January.

## †† RHODONEURA YPSILON.

*Banisia ypsilon*, Warr., Nov. Zool., 1899, p. 316.

Q., Gayndah. Also from Dammer Island.

## †† RHODONEURA ELONGATA.

*Banisia elongata*, Warr., Nov. Zool, 1896, p. 340.

N.Q., Cooktown.

## †† RHODONEURA DOHERTYI.

*Banisia dohertyi*, Warr., Nov. Zool., 1897, p. 196. Pl. v., f. 28.

*Rhodoneura stenosoma*, Hmps., P.Z.S., 1897. p. 617.

*Rhodoneura dohertyi*, Hmps., J. Bomb. Soc., 1897, p. 291.

Queensland (Hampson). Also from Bali, Malay Peninsula, and Ceylon.

## RHODONEURA FURCIFERA.

*Rhodoneura furcifer*, Hmps., J. Bomb. Soc., xiii., p. 230.

## RHODONEURA BASTIALIS.

*Pyralis bastialis*, Wlk., Brit. Mus. Cat. xix., p. 902.

*Rhodoneura bastialis*, Hmps., Moths Ind. i., p. 357.

N.Q., Geraldton, Townsville. Also from Solomons, Ceylon and India.

## RHODONEURA POLYGRAPHALIS.

N.Q., Thursday Island, Herberton.

## †† RHODONEURA MELILIALIS.

*Rhodoneura melilialis*, Swin., A.M.N.H. (7) vi., p. 312 (1900).

Q., Duaringa.

## ADDAEA POLYPHORALIS.

*Pyralis? polygraphalis*, Wlk., Brit. Mus. Cat. xxxiv., p. 1245, praeocc.

*Pyralis polyphoralis*, Wlk., Brit. Mus. Cat. xxxv., p. 1977.

*Mesopempta polyphoralis*, Meyr., Tr. E.S., 1887, p. 202.

I unfortunately overlooked Mr. Meyrick's description in which attention is called to Walker's second name. My suggested name, being a *nomen undum*, need not be retained in the synonymy.

N.Q., Kuranda. Q., Duaringa.

## FAM. PYRALIDAE.

## SUB-FAM. PHYCITINAE.

## HYPSTOTROPHA EURYZONA.

*Heosphora euryzona*, Meyr., Ent. Mo. Mag. xix., p. 256.

Rag., Rom. Mem. viii. Pl. 39., f. 13.

I was mistaken in citing this as *euryzonella*.

S.A., Wirrabara.

## †† HYPSTOTROPHA CHLOROGRAMMA.

*Heosphora chlorogramma*, Meyr., P.L.S.N.S.W., 1889, p. 1116.

I suspect that *H. rhodosticha*, Turn., may be a synonym of this species.

Q., Duaringa, Brisbane, Rosewood.

HYPSTOTROPHA STEREOSTICHA, *n. sp.*

στερεοστιχος, straight-lined.

♂ 17 m. (Head broken). Thorax whitish, irrorated with fuscous anteriorly. Abdomen pale ochreous; tuft whitish. Legs fuscous. Forewings elongate, costa nearly straight, apex rounded, termen obliquely rounded; whitish

with fuscous irroration ; base of costa dark fuscous ; a whitish costal streak almost free from irroration from base to near apex ; sharply bordered by a fuscous median streak from base to apex, ill-defined dorsally ; cilia whitish, with fuscous irroration. Hindwings whitish-grey ; cilia whitish.

Type (headless) in Coll. Turner.

I should not have described this imperfect example, if Sir Geo. Hampson had not suggested a name for it.

N.Q., Thursday Island.

*Gen. FOSSIFRONTIA.*

*Fossifrontia*, Hmps., Rom. Mem. viii., p. 338 (1901).

† FOSSIFRONTIA LEUCONEURELLA.

*Fossifrontia leuconeurella*, Hmps., Rom. Mem. viii., p. 339, Pl. 52, f. 19.

AMPYCOPHORA METAMELANELLA.

Q., Brisbane ; one specimen which Sir Geo. Hampson identifies with his unpublished species. In Part I it is referred to *Anerastria*.

AMPYCOPHORA HOLOPHAEA, *n. sp.*

ὄλοφαίος, wholly dusky.

♂ 16  $\Pi\Pi$ . Head and thorax fuscous. Palpi ( $1\frac{1}{2}$ ), upturned, not reaching vertex, fuscous. Antennae fuscous, in ♂ with basal joint dilated, beyond this strongly dilated anteroposteriorly, then simple, shortly ciliated ( $\frac{1}{2}$ ). Abdomen pale fuscous. Legs fuscous ; posterior pair ochreous-whitish above. Forewings narrow-elongate, costa gently arched, apex rounded, termen obliquely rounded ; uniformly fuscous, somewhat darker towards base ; cilia fuscous. Hindwings with termen rounded ; whitish, towards apex greyish-tinged ; cilia whitish, on costa and apex grey.

Type in Coll. Turner.

Q., Brisbane ; one specimen.

*Gen. MALIARPHA.*

Agrees in neururation with *Anerastria*, but the palpi, though porrect, are shorter, and with the terminal joint distinct, not hidden in the long hairs springing from the second joint. I cannot give the reference.

MALIARPHA MINIMELLA.

*Maliarpha minimella*, Hmps.

N.Q., Thursday Island ; one specimen.

## ANERASTRIA ENERVELLA.

*Erythphlebia enervella*, Rag., Rom. Mem. viii., p. 394.  
Pl. 39, f. 24.

## ANERASTRIA BISERIELLA.

*Anerastia biseriella*, Hmps., Rom. Mem. viii., p. 397.  
Pl. 52, f. 18.

ANERASTRIA PLINTHINA, *n. sp.*

πλανθινος, brick-coloured.

♀ 17-19 mm. Head and thorax dull reddish. Palpi long ( $3\frac{1}{2}$ ), porrect, terminal joint down-curved; dull reddish. Antennae dull-reddish, towards apices ochreous—whitish. Abdomen pale ochreous, with reddish lateral patches near apex. Legs fuscous; posterior pair whitish above. Forewings elongate, costa moderately arched, apex rounded. termen obliquely rounded; uniform dull reddish with a few fuscous scales towards costa; cilia pale reddish. Hindwings with termen rounded; whitish; cilia whitish.

Type in Coll. Turner.

N.A., Port Darwin; one specimen in Coll. Lyell.

N.Q., Townsville, in January; one specimen received from Mr. F. P. Dodd.

ANERASTRIA RHODONEURA, *n. sp.*

ροδονευρος, with rosy nerves.

♀ 25-27 mm. Head whitish: frons with an acute projecting tuft of hairs. Palpi moderate ( $2\frac{1}{2}$ ), porrect, terminal joint down-curved; whitish. Thorax whitish, sometimes rosy-tinged. Abdomen whitish ochreous. Legs whitish. Forewings elongate, posteriorly dilated, costa rather strongly arched, apex rounded, termen obliquely rounded; whitish; costa, termen, and veins of costal and terminal portions of disc rosy; cilia rosy. Hindwings with termen slightly sigmoid; whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Thursday Island; Kuranda, in April: two specimens.

## POUJADIA ERODELLA.

*Poujadia erodella*, Rag., Nouv. Gen., p. 42., Rom. Mem. viii. Pl. 37, f. 5.

## POUJADIA OPIFICELLA.

*Anerastia opificella*, Zel., Stett. Ent. Zeit, 1867, p. 406., Rag., Rom. Mem. viii. Pl. 44, f. 16.

## POUJADIA INFICITA.

*Acrobasis inficita*, Wlk., Brit. Mus. Cat. xxvii, p. 30.

*Poujadia inficita*, Hmps., Moths Ind. iv., p. 58.

Identified by Sir Geo. Hampson from a single ♀ example in poor condition, so I think some doubt is permissible.

Q., Dalby. Also from Ceylon and India.

## Gen. PARRAMATTA.

*Parramatta*, Rag., Rom. Mem. viii., p. 366.

## Gen. PAPUA

*Papua*, Rag., Bull. Soc. Ent. Fr., 1889, p. 220.

## PAPUA LATILIMBELLA.

*Papua latilimbella*, Rag., Bull. Soc. Ent. Fr., 1889, p. 220.  
Rom. Mem. viii. Pl. 36, f. 7.

## PAPUA LONGIRAMELLA.

*Emmalocera longiramella*, Hmps., Rom. Mem. viii., p. 315.  
Pl. 52, f. 16.

## HOMOEOSOMA VAGELLA.

V. Birchip (*Goudie*), Gisborne (Lyell).

## HOMOEOSOMA FARINARIA.

N.S.W., Sydney; one ♀ example with the posterior line completely obsolete, and the anterior ill-marked. Otherwise it agrees with the type.

## Gen. EUCAMPYLA.

I have not been able to examine an example of this genus, but Mr. Meyrick states that the forewings have eleven veins, and it is therefore wrongly placed in my tabulation. Perhaps it should be referred to the neighbourhood of *Euzophera*.

## Gen. SYNTYPICA, nov.

συντυπικός, similarly stamped, of similar structure.

Face flat. Tongue present. Palpi long, porrect; terminal joint distinct, somewhat down-curved. Maxillary palpi well-developed, filiform. Antennae of ♀ simple, minutely ciliated. Forewings with 4 and 5 stalked, 8 absent. Hindwings with 3 and 4 separate, 5 absent, 7 anastomosing with 8 to near apex.

In neuration this genus agrees with *Homoeosoma*, but the palpi are very different. In my tabulation it should be placed in the position wrongly occupied by *Eucampyla*.

SYNTPYICA ALEURODES, *n. sp.**ἀλευρωδης*, floury.

♂ 26 mm. Head whitish. Palpi long ( $3\frac{1}{2}$ ), grey, internal surface whitish. Antennae pale ochreous. Thorax pale grey. Abdomen pale ochreous, postmedian half except tuft fuscous-tinged. Legs grey, mixed with whitish; posterior pair whitish. Forewings elongate, costa gently arched, apex rounded, termen obliquely rounded; grey densely irrorated with whitish; an ill-defined whitish median streak occupying cell; two grey dots, one at each angle of cell; a terminal series of faint grey dots; cilia whitish. Hindwings with termen rounded; grey-whitish; cilia whitish.

Type in Coll. Lyell.

V. Birchip, in November; one specimen received from Mr. D. Goudie.

*Gen. EUZOPHERODES.*

*Euzopherodes*, Hmps., J. Bomb. Soc., 1897, p. 475. Rom. Mem. viii., p. 79.

## EUZOPHERODES ALBICANS.

*Euzopherodes albicans*, Hmps., J. Bomb. Soc. 1897, p. 475. Rom. Mem. viii., p. 79., Pl. xxx, f. 23.

Also from Ceylon and India.

## EUZOPHERODES LEPTOCOSMA.

V., Birchip, in April (*Goudie*).

*Gen. UNADILLA.*

*Unadilla*, Hulst., Trans. Am. Ent. Soc. xvii, p. 197 (1890).

## UNADILLA DISTICHELLA.

Q., Helidon; T., Hobart (*Lea*).

UNADILLA APATELIA, *n. sp.**ἀπατηλιος*, deceitful.

♀. 17 mm. Head and thorax pale fuscous. Palpi fuscous, towards base whitish. Antennae ochreous-whitish. Abdomen grey-whitish; dorsum of basal segments and tuft ochreous. Legs whitish, irrorated with fuscous; tarsi fuscous with whitish annulations. Forewings elongate, costa slightly arched, apex round-pointed, termen obliquely rounded; fuscous; costa from  $\frac{1}{4}$  to near apex broadly white; a fuscous dot beneath  $\frac{2}{3}$  costa; cilia pale fuscous. Hindwings with termen rounded, slightly sinuate beneath apex; grey-whitish; elia grey with a whitish basal line, at tornus whitish.



Type in Coll. Turner is rather wasted and very closely resembles *Hyphantidium albicostale*, with which I formerly confused it. Apart from the absence of vein 5 of forewings, the ochreous abdomen appears to be a good distinguishing point.

Q., Brisbane, in November, one specimen.

Gen. ANCYLODES.

*Ancyloides*, Rag., Ann. Soc. Ent. Fr. 1887, p. 250.

Neuration as in *Crocodypora*, but differing in the palpi and antennae as described below. Sir Geo. Hampson refers the following species to this genus, which is inconsistent with a note in J. Bomb. Soc. 1897, p. 314. Unfortunately I am unable to consult Ragonot's diagnosis.

ANCYLODES PENICILLATA, *n. sp.*

Penicillum, a fine brush (in allusion to the maxillary palpi).

♂ 18 mm. Head and thorax grey. Palpi in ♂ strongly ascending, not recurved, exceeding vertex, second and terminal joints strongly dilated, the latter obtuse; grey. Maxillary palpi in ♂ ending in a pencil of very long whitish hairs. Antennae grey; in ♂ with basal joint dilated, shaft beyond this very strongly dilated anteroposteriorly, then simple, minutely ciliated. Abdomen grey, towards base ochreous-tinged. Legs grey mixed with whitish; posterior pair mostly whitish. Forewings elongate, costa gently arched, apex rounded, termen obliquely rounded; pale grey with a few scattered fuscous scales; a fine sharply dentate broken dark fuscous line from  $\frac{1}{3}$  costa to  $\frac{1}{3}$  dorsum; two dark fuscous discal dots placed transversely at  $\frac{2}{3}$ ; some fuscous streaks on veins at  $\frac{1}{3}$  representing a posterior line; followed by a fine dentate obscure whitish line; and this again by some streaks representing a sub-terminal line; two or three fuscous terminal dots; cilia grey with whitish points. Hindwings with termen rather sinuate; pale grey; cilia pale grey with a faintly darker basal line.

Type in Coll. Lyell.

V., Murtoa, in February, one specimen.

EUZOPHERA THERMOCHROA.

Q., Brisbane.

## HYPHANTIDIUM ALBICOSTALE.

*Homoeosoma ? alborcostalis*, Luc., P.R.S.Q. 1891, p. 93.

As noted above I was in error in referring this species to *Unadilla*.

N.Q., Kuranda, Townsville; Q., Bundaberg, Brisbane, Stradbroke Island.

## HYPHANTIDIUM QUADRIGUTTELLUM.

Q. Brisbane.

## HYPHANTIDIUM LEUCARMUM.

V., Birchip (*Goudie*).

## HYPHANTIDIUM APODECTUM.

N.S.W., Sydney (*Lyell*).

HYPHANTIDIUM HEMIBAPHES, *n. sp.*

ἡμιβαφης, half-dyed.

♂ 24 mm. Head, palpi, thorax, and abdomen pale ochreous. Antennae fuscous; in ♂ simple, non-ciliated. Legs dark fuscous; posterior pair whitish-ochreous on inner aspect. Forewings strongly dilated posteriorly, costa moderately arched, apex round-pointed, termen obliquely rounded; fuscous with dull purplish reflections; basal  $\frac{2}{3}$  except towards costa pale ochreous with a few reddish and fuscous scales, posterior edge of basal patch sharply defined, from  $\frac{2}{3}$  costa outwardly curved, then straight to mid-dorsum; costal irroration forming an ill-defined triangle encroaching on basal patch; a reddish-brown apical blotch extending to mid-termen; cilia grey with a whitish basal line. Hindwings with termen rounded, slightly sinuate beneath apex; pale grey; cilia pale grey; underside in ♂ with a patch of long ochreous hairs in disc.

Type in Coll. Lyell.

T. Hobart, in February, one specimen.

*Gen. MESEINIADIA.*

Hindwings with vein 5 absent. Forewings with 2 and 3 stalked, 5 present, 8, 9, 10 stalked. Palpi recurved, ascending. These characters suffice to distinguish the genus from any in my tabulation. I cannot give a reference for the name, which is given me by Sir Geo. Hampson.

## MESEINIADIA INFRACTALIS.

*Nephopteryx infractalis*, Wlk., Brit. Mus. Cat. xxx, p. 958.

N.Q., Geraldton, in November; one specimen.

Also from Borneo.

*Gen. TYLOCHARES.*

*Tylochaeres*, Meyr., Ent. Mo. Mag. xix, p. 256 (1883).

## TYLOCHARES COSMIELLA.

S.A., Wirrabara (*Meyrick*).

## TRISSONCA IANTHEMIS.

*Tylochaeres* ? *ianthemis*, Meyr., Tr.E.S., 1887, p. 260.

*Trissonca epiterpes*, Turn., P.R.S.Q. 1903, p. 132.

In one of my examples veins 4 and 5 of forewings are shortly stalked.

N.Q., Kuranda, Townsville, in January, February, and March ; three ♀ specimens received from Mr. F. P. Dodd.

*Gen. HYPOGRYPHIA.*

*Hypogryphia*, Rag., Bull. Soc. Ent. Fr. 1890, p. 119.

## HYPOGRYPHIA RUFIFASCIELLA.

*Hypogryphia rufifasciella*, Hmps., Rom. Mem. viii, p. 193, Pl. 48, f. 24.

*Gen. MYELOIS.*

*Myelois*, Hb., Verz., p. 371. Hmps., Moths Ind. iv, p. 88.

Distinguished from *Phycita* and *Hypargyria* by the cell of hindwings being relatively longer ( $\frac{1}{2}$ ), whereas in the former genera it does not exceed  $\frac{1}{3}$ . In the forewings, 4 and 5 are typically stalked, but in the solitary specimen examined of the following species, they are short-stalked on one side, separate but approximate on the other. From *Odontarthria* it is distinguished by the large maxillary palpi dilated with scales at their apices. Sir Geo. Hampson does however describe the maxillary palpi (*loc. cit.*) as filiform, which makes me doubt whether the following species is correctly referred.

## MYELOIS GROSSIPUNCTELLA.

*Myelois grossipunctella*, Rag.

V., Gisborne, in November, one specimen in Coll. Lyell.

PTYOBATHRA, *n. g.*

πτυοβαθρος, with fan-like base ; in allusion to the basal joint of antennae.

Tongue well developed. Palpi ascending, second joint closely appressed to frons and reaching vertex, terminal joint minute, porrect, bent at right angles to second joint. Maxillary palpi in ♂ with a terminal pencil of long hairs. Antennae with a large fan-like appendage projecting backwards from end of basal joint ; shaft in ♂ with a fusiform thickening

at about  $\frac{1}{5}$ , very minutely ciliated. Forewings with 4 and 5 approximated at base, 8 and 9 stalked. Hindwings with cell about  $\frac{1}{2}$ , 2 from before angle, 3 closely appressed to 4 for some distance, 4 and 5 stalked, 7 anastomosing with 8.

One of the *Phycita* group. The terminal joint of the palpi is bent forward as in *Tephritis*, but vein 2 of hindwings is from well before angle. The antennal structure is peculiar.

PTYOBATHRA HYPOLEPIDOTA, n. sp.

ὑπολεπιδωτος, scaled beneath; in allusion to the dark scales on under surface of forewings.

♂ 22 m m Head, thorax, palpi, and antennae ochreous-brown with a few fuscous scales. Abdomen ochreous-brown with three pairs of large squarish black spots on basal segments. Legs ochreous-brown mixed with dark fuscous. Forewings elongate, posteriorly dilated, costa moderately and evenly arched, apex rounded rectangular, termen first straight and then obliquely rounded; ochreous-brown with some fuscous scales; a fuscous irroration of costal area from base to  $\frac{1}{3}$ ; a dot in cell and two others at end of cell with scattered fuscous scales in cell and on veins, these form an interrupted subterminal line; a terminal series of dots between veins; cilia ochreous-brown. Hindwings with termen rounded; translucent white; a fuscous terminal line obsolete towards tornus; cilia white with a fuscous basal line obsolete towards tornus. Under side densely irrorated with black scales along costal veins to  $\frac{1}{2}$ .

Obscurely coloured above but easily recognised by the black irroration beneath.

Type in Coll. Lyell.

N.W.A., Roeburne, one specimen.

PHYCITA EULEPIDELLA.

*Phycita eulepidella*, Hmps., Moths Ind. iv. p. 94.

*Phycita recondita*, Turn., P.R.S.Q., 1903, p. 143.

N.Q., Townsville (*Dodd*). Also from Ceylon.

PHYCITA CEROPREPIELLA.

*Salebria ceroprepiella*, Hmps., Rom. Mem. viii, p. 550, Pl. 57, f. 16.

PHYCITA AUTOMORPHA.

*Conobathra automorpha*, Meyr., Tr. E. S. 1886, p. 271.

*Phycita corethropus*, Turn., P.R.S.Q. 1903, p. 136.

Veins 4 and 5 of forewings may be either stalked or approximated at base. I am disposed to recognise Mr. Meyrick's genus as valid, but postpone the subdivision of *Phycita* for the present.

N.Q., Townsville. Also from New Guinea.

PHYCITA SAGITTIFERELLA.

*Citripestis sagittiferella*, Moore.

Q., Brisbane; one ♂ in Coll. Lyell.

PHYCITA AUCHMODES, n. sp.

ἀνχυσωδης, squalid.

♂ 18 m m. Head fuscous. Palpi fuscous, in ♂ dilated, exceeding vertex, closely appressed to frons, and recurved at apices. Antennae fuscous; in ♂ notched internally at  $\frac{1}{2}$ , thickened before and after notch, very minutely ciliated. Thorax grey. Abdomen pale grey. Legs fuscous with some whitish scales; middle tibiae in ♂ dilated; posterior tibiae in ♂ with a pencil of long hairs from base and a shorter tuft at apex. Forewings elongate-triangular, costa moderately arched, apex rounded, termen rounded, oblique; grey mixed with fuscous and white; a whitish line with a posterior dentation in mid-disc from  $\frac{1}{4}$  costa to  $\frac{2}{5}$  dorsum; two fuscous discal dots placed transversely beneath mid-costa; a fine whitish dentate sub-terminal line; an obscure series of dark fuscous terminal dots; cilia whitish grey. Hindwings with termen slightly sinuate; dorsal margin turned over beneath in ♂; pale grey; cilia whitish-grey.

This species appears to be referable to *Thylacoptila*, Meyr.

Type in Coll. Turner.

Q., Brisbane, in April; one specimen. There is also an example in the British Museum from the Malay Peninsula.

NEPHOPTERYX NODICORNELLA.

*Nephopteryx nodicornella*, Rag., Nouv. Gen. p. 21., Mon. Phyc., p. 386, Pl. 43, f. 14. Hmps., Moths Ind., iv, p. 84.

I took six examples showing considerable variation among mangrove below high water mark, and would like to be in a position to confirm Sir Geo. Hampson's identification.

Q., Burpengary near Brisbane, in April. Also from India.

## NEPHOPTERYX CAPNOËSSA.

*Trissonca capnoëssa*, Turn., P.R.S.Q. 1903, p. 133.

I assigned this species to *Trissonca* by an error of observation.

## EPICROCIS SUBLIGNALIS.

N.Q., Geraldton.

## Gen. HYPOPHANA.

*Hypophana*, Meyr., P.L.S.N.S.W. 1882, p. 159.

Differs from *Phycita* in the extremely short cell of hindwings, not exceeding  $\frac{1}{2}$ . In this it agrees with *Spatulipalpia*, but veins 4 and 5 are long-stalked. This note refers only to the following species, as I have not been able to examine the others referred to the genus.

## HYPOPHANA PETALOCOSMA.

*Hypophana petalocosma*, Meyr., P.L.S.N.S.W. 1882, p. 169.

*Spatulipalpia sophronica*, Turn., P.R.S.Q. 1903, p. 149.

In my ♂ example the pectoral appendages are well-developed.

N.Q., Townsville (Dodd). N.S.W., Sydney.

## SPATULIPALPIA DISSOLUTELLA.

*dissolutella*, Snel., Midd. Sum. Lep. p. 81.

*Cryptoblabes dissolutella*, Hmps., Moths Ind. iv, p. 105.

Q., Brisbane, in May, one ♂. Also from Celebes and India.

## CRYPTOBLABES OENOBARELLA.

V., Birchip (Goudie), Gisborne (Lyell).

## CRYPTOBLABES ADOCETA.

N.Q., Kuranda (Dodd).

## CRYPTOBLABES EURAPHELLA.

*Nephopteryx euraphella*, Meyr., P.L.S.N.S.W. 1879, p. 217.

Q., Brisbane. N.S.W., Wollongong.

## Gen. STEREOBELA, nov.

στερεοβελος, with straight weapons, i.e., palpi.

Frons flat. Tongue obsolete (?). Palpi long, straight, porrect or drooping; terminal joint short, obtuse. Maxillary palpi more than half labial in length, stout throughout, obtuse. Antennae in ♂ thickened, simple, ciliated. Forewings with 4 and 5 connate, 8 and 9 stalked. Hindwings with cell long (nearly  $\frac{1}{2}$ ), 3 from angle well separated from 4 and 5 which are short stalked.

## STEREOBELA LEUCOMERA.

*λευκομερος*, partly white.

♂ 15 mm. Head whitish. Palpi fuscous. Antennae ochreous-whitish; ciliations in ♂ 1. Thorax pale fuscous. Abdomen ochreous-whitish. Legs whitish with fuscous irroration, Forewings elongate-triangular, costa straight, apex rounded, termen slightly rounded, oblique; pale fuscous-grey, towards termen suffused with white; a broad outwardly oblique white fascia from  $\frac{1}{3}$  costa, barely reaching fold, and becoming suffused in disc; a broad suffused white triangular patch on costa from shortly beyond fascia to near apex; a short dark triangular streak at apex; a fine dark terminal line; cilia pale grey with white points. Hindwings with termen slightly wavy, scarcely rounded; whitish, with grey irroration, most marked on apex and termen; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in December, one specimen received from Mr. F. P. Dodd.

## Gen. SCLEROBIA.

*Sclerobia*, Rag., Rom. Mem. vii, p. 528 (1893).

## SCLEROBIA TRITALIS.

Q., Nanango. T., Swansea (*Lea*). W.A., Bridgetown (*Coll. Lyell*).

## ETIELLA BEHRI.

Q., Nanango, Cunnamulla. V., Birchip. T., Strahan.

## ETIELLA WALSINGHAMELLA.

*Etiella walsinghamella*, Rag., Nouv. Gen., p. 27. Rom. Mem. vii, p. 577, Pl. 21, f. 4.

## ETIELLA MELANELLA.

*Etiella melanella*, Hmps., Rom. Mem. viii, p. 558, Pl. 57, f. 24.

## SUB. FAM. GALLERIANAE.

## Gen. CORCYRA.

*Corcyra*, Rag., Ent. Mo. Mag. xxii, p. 23 (1885).

## CORCYRA CEPHALONICA.

*Corcyra cephalonica*, Rag., Meyr., Brit. Lep., p. 384.

I have bred this species in Brisbane from larvae feeding in the bodies of large moths received from Thursday Island.

N.Q., Kuranda, Townsville. Q., Brisbane. Also from Europe.

*Gen. PARALIPSA.**Paralipsa*, Butl., A.M.N.H. (5) iv, p. 454 (1879).*Gen. MELISSOBLAPTES.**Melissoblaptēs*, Zel., Isis, 1839, p. 180.

## MELISSOBLAPTES SORDIDELLA.

N.S.W., Sydney, in April, one ♂ in Coll. Lyell.

## MELISSOBLAPTES UNICOLOR.

*unicolor*, Stgr.

I do not know the reference.

N.Q., Townsville, in September, one specimen received from Mr. F. P. Dodd.

MELISSOBLAPTES HOMOCHROA, *n. sp.*

ὁμοχρῶος, of one color.

♀ 26 mm. Head and palpi whitish grey. Antennae grey. Thorax, abdomen, and legs whitish-grey. Forewings oval, costa moderately arched, apex rounded, termen obliquely rounded; whitish-grey; cilia whitish-grey. Hindwings with termen rounded, slightly sinuate beneath apex; whitish-grey; cilia whitish-grey.

Type in Coll. Turner.

Q., Brisbane, one specimen.

*Gen. DOLOESSA.**Doloëssa*, Zel., Isis, 1848, p. 860.

## DOLOESSA CASTANELLA.

*Thajora castanella*, Hmps., Moths Ind iv, p. 4 (1896).*Melissoblaptēs hilaropis*, Meyr., Tr.E.S. 1897, p. 378.

In my example, which was identified by Sir Geo. Hampson with *castanella*, the lines on forewing are very obscure, but can just be traced. In Part I *hilaropis* is erroneously quoted twice.

*Gen. HETEROMICTA.**Heteromicta*, Meyr., Tr.E.S. 1886, p. 273.

## HETEROMICTA PACHYTERA.

Q., Toowoomba.

## † HETEROMICTA OCHRACELLA

*Heteromicta ochraceella*, Hmps., Rom. Mem. viii, p. 455, Pl. 54, f. 1.

## †† HETEROMICTA NIGRICOSTELLA.

*Heteromicta nigricostella*, Hmps., Rom. Mem. viii, p. 455, Pl. 54, f. 3.



HETEROMICTA POEODES, *n. sp.*

πρωδης, grass green.

♂ 16 m. Head and palpi greenish-grey. Antennae whitish. Thorax green. Abdomen whitish. Legs whitish. irrorated and annulated with fuscous. Forewings elongate-triangular, costa gently arched, apex rounded, termen rounded, oblique; bright green with a very few fuscous scales; an irregularly shaped dark-fuscous discal spot at  $\frac{1}{2}$ ; a series of dark-fuscous dots on apical third of costa continued round apex and termen; cilia greenish-grey. Hindwings with termen sinuate; whitish-grey; cilia whitish.

Veins 4 and 5 of forewings are stalked.

Type in Coll. Turner.

N.Q., Kuranda, in May, one specimen received from Mr. F. P. Dodd.

## TIRATHABA RUFIVENA.

N.Q., Kuranda.

## TIRATHABA ACROCAUSTA.

*acrocausta*, Meyr., Tr. E.S., 1899, p. 79.

## †† TIRATHABA CHLOROSEMA.

*Tirathaba chlorosema*, Low., Tr.R.S.S.A. 1903, p. 219.

N.Q., Mackay ?.

Probably a synonym of *T. rufivena*.

## TIRATHABA PARASITICA.

*Melissoblastes parasiticus*, Luc., P.R.S.Q. 1898, p. 85.

*Harpagoneura hepialivora*, Hmps., Rom. Mem. viii, p. 466, Pl. 53, f. 19 (1901).

N.Q., Townsville. Q. Brisbane. N.S.W., Sydney (*Lyell*).

## Gen. STENACHROIA.

This genus agrees with *Meliphora* in neururation, but is distinguished by having a long pointed frontal tuft and longer palpi. I cannot give a reference for the name.

STENACHROIA MYRMECOPHILA, *n. sp.*

μυρμηκοφίλος, ant-loving.

♀ 18-22 m. Head, palpi, antennae, thorax and abdomen fuscous. Legs fuscous with obscure whitish annulations. Forewings elongate-oval, costa strongly arched, apex rounded, termen obliquely rounded; grey, irrorated with dark fuscous, cilia grey. Hindwings with termen strongly sinuate; grey; cilia pale grey.

Type in Coll. Turner.

N.Q., Townsville. in November and December; three specimens bred by Mr. F. P. Dodd, who states that "the larva is very dark, active, and more hairy than pyrales usually are; it may be found moving about quite freely with the ants, and pupates in the main or side galleries, the cocoon is oval and covered with tiny bark fragments, grass, etc." The species of ant alluded to builds its galleries in trees.

LAMORIA ADAPTELLA.

N.Q., Kuranda; Q., Mount Tambourine.

† LAMORIA PACHYLEPIDELLA.

*Lamoria pachylepidella*, Hmps., Rom. Mem. viii., p. 441. Pl. 53. f. 3.

LAMMORIA OENOCRHOA, n. sp.

*ovoxpoos*, wine-coloured.

♂ 28 m. Head, thorax and palpi pale reddish-purple. Antennae, dull ochreous. Abdomen whitish. Legs whitish; anterior pair tinged with reddish-purple. Forewings oval, costa strongly arched, apex rounded, termen obliquely rounded; pale reddish-purple; cilia (rubbed). Hindwings with termen rounded; ochreous-whitish; apex tinged with fuscous; cilia pale fuscous, on tornus and dorsum whitish.

Type (rather wasted) in Coll. Turner.

I should have doubted whether this were distinguishable from *adaptelella*, but for a difference in the neuriation; veins 4 and 5 of forewings are widely separate at base, not connate as in that species.

Q., Nambour, in September; one specimen.

Gen. EUCALLIONYMA.

*Eucallionyma*, Rag., Rom. Mem. viii., p. 430 (1901).

SUB-FAM. CRAMBINAE.

CULLADIA ADMIGRATELLA.

N.Q., Kuranda.

CRAMBUS LEPTOGRAMMELLUS.

V. Birchip.

CRAMBUS CUNIFERELLUS.

Q., Nanango, Toowoomba.

ARGYRIA AMOENALIS.

*amoenalis*, Suel., Tijd. v. Ent. 1880, p. 247. 1883, Pl. v., f. 9.

N.Q., Cairns.

## UBIDA RAMOSTRIELLA.

Q., Nambour.

## UBIDA HOLOMOCHLA.

N.Q., Thursday Island.

*Gen. DIADEXIA, nov.**δαδεξιος*, of good omen.

Frons with a pointed conical projection. Tongue weakly developed. Labial palpi long, drooping. Maxillary palpi triangularly dilated. Antennae of ♂ with a single outer row of pectinations, apical fourth serrate. Forewings with veins 5 and 7 absent, 8 and 9 stalked, 11 free. Hindwings with 5 absent, 6 from upper angle of cell, 7 anastomosing strongly with 8.

In my tabulation this falls with *Culladia*, from which it is distinguished by the projecting frons, and the highly peculiar unipectinate antennae of the ♂. I think, however, its natural affinities are rather with *Chilo*.

DIADEXIA PARODES, *n. sp.**παρωδης*, reddish-brown.

♂ 20 mm. Head and palpi pale ochreous-brown. Antennae ochreous-brown, towards apex fuscous; pectinations in ♂ 2½. Thorax ochreous-brown, irrorated with reddish-brown. Abdomen whitish-ochreous. Legs whitish-ochreous. Forewings elongate; ochreous-brown, irrorated with reddish-brown; a suffused median reddish-brown fascia containing some blackish scales; a blackish streak on vein 1 in and beyond fascia; a pale dentate line from  $\frac{1}{5}$  costa to  $\frac{2}{3}$  dorsum, preceded and followed by some fine short longitudinal blackish streaks; cilia brown-whitish. Hindwings with termen rounded; whitish; cilia whitish.

Type in Coll. Lyell.

N.W.A., Roeburne; one specimen.

## CHILO OCELLEUS.

*ocellea*, Haw., Brit. Lep. p. 486.*Euchromius ocellus*, Meyr., Brit. Lep., p. 396.*Eromene ocella*, Hmps., Moths Ind. iv., p. 24.

I see no sufficient reason for separating this species from *Chilo*. In the only example I have examined, vein 11 of forewings is bent and approximated to 12, and 4 and 5 of hindwings are stalked; no doubt these points are subject to variation.

N.S.W., Broken Hill (*Lower*); S.A., Mount Lofty (*Meyrick*, Tr. E.S., 1887, p. 251); N.W.A., Roeburne; one specimen in Coll. Lyell. Also from India and Europe.

CHILO LATIVITTALIS.

T. Strahan.

SEDENIA CERVALIS.

N.S.W., Glen Innes, Cooma (*Meyrick*).

SEDENIA RUPALIS.

N.S.W., Glen Innes, Bathurst, Cooma; T., Launceston; S.A., Mount Lofty; W.A., Carnarvon (*Meyrick*).

†† SEDENIA ASPASTA.

*Sedenia aspasta*, Meyr., Tr. E.S., 1887, p. 244.

W.A., Carnarvon.

SEDENIA LEUCOPEPLA, *n. sp.*

λευκοπεπλος, white-cloaked.

♂ 16-19 mm. Head, palpi, thorax and abdomen ochreous-whitish. Antennae ochreous-whitish; in ♂ with short ciliations ( $\frac{1}{2}$ ). Legs ochreous-whitish. Forewings elongate-triangular, costa scarcely arched, apex rounded, termen very obliquely rounded; ochreous-whitish sparsely irrorated with pale brownish-fuscous, and with suffused markings of this colour; a line from  $\frac{1}{4}$  costa to  $\frac{1}{2}$  dorsum; a discal spot beneath mid-costa; an inwardly oblique line from  $\frac{2}{5}$  costa strongly bent inwards at  $\frac{3}{5}$  to before discal spot, then bent again to reach dorsum at  $\frac{3}{5}$ ; cilia whitish. Hindwings with termen rounded; whitish; a fuscous line from  $\frac{1}{2}$  costa not reaching middle; traces of a similar line from dorsum above tornus; cilia whitish. Underside similar.

Type in Coll. Lyell.

N.W.A., Roeburne; two specimens received from Mr. G. Lyell.

DIPTYCHOPHORA OCHRACEALIS.

N.Q., Kuranda (*Dodd*).

DIPTYCHOPHORA DIARGEMA, *n. sp.*

διαργεμος, flecked with white.

♀ 12 mm. Head, antennae, thorax and abdomen whitish. Palpi, long ( $4\frac{1}{2}$ ); pale fuscous. Legs whitish; apical joint of posterior tarsi fuscous. Forewings triangular, costa nearly straight, apex rounded, termen oblique, nearly straight, but incised beneath apex; whitish with some greyish irroration; a fine straight grey line from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum;

a transverse linear grey median discal mark ; a second fine line from  $\frac{3}{4}$  costa, outwardly curved, then bent strongly inward beneath discal mark, to end in  $\frac{3}{4}$  dorsum ; terminal area of disc suffused with grey and ochreous ; a short white longitudinal streak beneath apex bounded above and beneath by ochreous ; a short white streak at incision continued through cilia ; a similar streak at mid-termen ; three blackish dots in a small ochreous suffusion on lower part of termen ; cilia leaden-fuscous with a whitish median line, interrupted by clear white at incision and mid-termen. Hindwings with termen rounded ; whitish ; termen greyish, cilia whitish, with a leaden-fuscous basal line at apex.

Type in Coll. Turner.

N.Q., Kuranda ; in June ; one specimen received from Mr. F. P. Dodd.

TALIS BRUNNEA.

N.W.A., Roeburne ; one example in Coll. Lyell.

TALIS BIVITTELLA.

T., Hobart.

SUB-FAM. CHRYSAUGINAE.

CURICTA OPPOSITALIS.

N.Q., Kuranda : in October ; one specimen received from Mr. F. P. Dodd.

SUB-FAM. PYRALINAE.

ENDOTRICHA DISPERGENS.

N.Q., Kuranda.

ENDOTRICHA MESETERIALIS.

N.Q., Atherton.

ENDOTRICHA PYROSALIS.

Q., Warwick.

ENDOTRICHA PUNCTICOSTALIS.

Q., Cunnamulla. N.S.W., Sydney.

ENDOTRICHA AGLAOPA.

V., Gisborne, in November ; one ♂ taken by Mr. G. Lyell.

ENDOTRICHA CAUSTOPA, *n. sp.*

καυστωπος, scorched.

♂ 24 m. Head and thorax reddish-brown. (Palpi broken). Antennae reddish-brown ; in ♂ with long ciliations (4). Abdomen reddish-brown ; a broad streak on dorsum

dark-fuscos; tuft fuscous. Legs purplish-brown; posterior pair pale ochreous; anterior coxae ochreous with a few purplish scales; tarsi annulated with pale ochreous. Forewings triangular, costa straight except towards apex, apex round-pointed, termen bowed, oblique; dull reddish-brown sparsely irrorated with fuscous; lines fuscous: first straight, somewhat suffused, from  $\frac{1}{3}$  costa to  $\frac{1}{3}$  dorsum; a minute fuscous discal dot beneath mid-costa; second line finer from  $\frac{2}{3}$  costa, straight to near dorsum, then bent outwards to tornus, followed by a dark brown suffusion; a terminal series of minute fuscous dots; cilia pale reddish. Hindwings with termen slightly sinuate; colour as forewings, but suffused with fuscous before first and between first and second lines; a third line near and parallel to first; cilia as forewings, but on tornus and dorsum ochreous. Underside as upper, but with less fuscous suffusion, and first lines obscure.

Type in Coll. Lyell.

N.Q., Kuranda, in September; one specimen received from Mr. F. P. Dodd.

DIPLOPSEUSTIS PERIERESALIS.

V., Birchip.

COTACHENA HISTRICALIS.

N.Q., Cairns, Kuranda.

COTACHENA ALUENSIS

N.Q., Kuranda.

PYRALIS MANIHOTALIS.

V., Birchip (*Goudie*).

VITESSA ZALMIRA.

*zalmira*, Cram., Pap. Exot. iv., p. 149. Pl. 367, f. 2.

N.Q., Kuranda, in April; one specimen received from Mr. Rowland Turner. Also from New Hebrides and Amboyna.

VITESSA GLAUOPTERA.

N.Q., Atherton (Coll. Lyell); Kuranda, in March and September; two specimens received from Mr. F. P. Dodd.

Gen. HYPsidia.

*Hypsidia*, Roths., Nov. Zool. iii., p. 602 (1896).

From the definition given of this genus it appears to be allied to *Vitessa* and *Cardamyla*, but may be readily distinguished by vein 10 of forewings being stalked with 8 and 9.

## † HPYSIDIA ERYTHROPSALIS.

*Hypsidia erythropsalis* Roths., Nov. Zool. iii., p. 603.

## BOSTRA DISTICHA.

N.Q., Cairns, Kuranda.

## TITANOCEROS CATAXANTHA.

Q., Nanango.

## Gen. CATAMOLA.

*Catamola*, Meyr., Tr.E.S. 1884, p. 178.

*Nyctereutica*, Turn., P.R.S.Q. 1903, p. 192.

Type *C. funerea*, Wlk. Mr. Meyrick subsequently sank his genus in *Epipaschia* from which it is distinguished by the long anastomosis of veins 7 and 8 of hindwings; in *Epipaschia* these veins are either separate or anastomose very shortly. The genus is a natural one; all the species are dark-fuscou or blackish.

## CATAMOLA FUNEREA.

I previously overlooked the fact that this common species is certainly referable to my genus *Nyctereutica* of which *Catamola*, Meyr., is an older name.

N.Q., Townsville.

## CATAMOLA CAPNOPIS.

V., Gisborne (*Lyell*).

## MACALLA CONCISELLA.

N.Q., Kuranda.

## MACALLA AERUGINOSA.

Q., Nambour.

MACALLA MNIARIAS, *n. sp.*

*μνιapos*, mossy.

♂ 24 m m. Head and palpi greenish. Antennae ochreous-fuscou; in ♂ ciliated in tufts (2); processes green, posteriorly brownish. Thorax brownish with some green scales and a posterior blackish spot; basal ⅓ of patagia green. Abdomen pale reddish-brown; a transverse blackish line on second segment; tuft greenish tinged. Legs whitish mixed with brownish and dark-fuscou; anterior and middle tarsi dark-fuscou with whitish annulations. Forewings triangular, costa straight, towards apex slightly arched, apex rounded, termen bowed, oblique; green; markings pale reddish-brown irrorated sparsely with blackish scales;

a spot on base of dorsum ; a transverse fascia at  $\frac{1}{4}$  ; succeeded by a parallel line, obsolete towards costa, where it is represented by a blackish dot ; a broader fascia beyond middle ; and a subterminal fascia interrupted in mid-disc ; some fuscous terminal dots ; cilia whitish tinged with reddish and obscurely barred with fuscous. Hindwings with termen rounded ; pale fuscous ; termen reddish tinged ; cilia pale reddish.

Type in Coll. Turner.

N.Q., Kuranda, in October ; one specimen received from Mr. F. P. Dodd.

MACALLA DOCHMOSCIA, *n. sp.*

δοχμοσκιος, obliquely shaded.

♂ 28 m. Head, palpi, thorax, and antennal processes fuscous irrorated with white. Antennae pale fuscous ; in ♂ slightly pectinate (1). Abdomen ochreous-whitish. Legs dark-fuscous irrorated and annulated with whitish ; posterior tibiae whitish, towards apex pale reddish with some dark-fuscous scales. Forewings triangular, costa straight for  $\frac{2}{3}$ , then moderately arched, apex rounded, termen bowed, oblique ; white irrorated with brownish and dark-fuscous ; a pale-grey spot on dorsum near base ; a broad oblique dark shade from  $\frac{1}{4}$  costa to tornus ; a dark-fuscous spot on mid-costa, and another at  $\frac{5}{8}$  ; a fine, indistinct, sharply dentate subterminal line, obsolete towards costa ; followed by a brownish shade more or less interrupted ; a terminal series of dark-fuscous wedge-shaped dots ; cilia white barred with pale reddish, the bases of bars fuscous. Hindwings with termen rounded ; towards base and dorsum whitish, towards apex and termen fuscous ; cilia pale reddish, with a whitish basal line, followed by an interrupted fuscous line obsolete towards tornus.

Type in Coll. Turner.

N.Q., Kuranda, in March ; one specimen received from Mr. F. P. Dodd.

EPIPASCHIA CLETOIJS, *n. sp.*

κλητολις, worth choosing.

♂ 30 m. Head whitish. Palpi brownish suffused with whitish anteriorly. Antennae whitish-ochreous ; in ♂ with short processes not reaching middle of tegulae, towards base slightly serrate, moderately ciliated (1). Thorax



whitish-brown mixed with darker brown and fuscous. Abdomen whitish irrorated with brown, especially towards base; apices of middle and posterior segments edged with blackish. Legs brown, tarsi annulated with ochreous-whitish; posterior pair reddish-tinged. Forewings triangular, costa straight, towards apex slightly arched; apex rounded, termen bowed, oblique; whitish; a reddish-brown basal patch to  $\frac{1}{2}$ , towards dorsum suffused with dull greenish, posterior edge straight; a greenish line from middle of posterior edge and parallel with it to dorsum; a reddish-brown spot on midcosta, followed by two similar spots; between these and dorsum is some brownish and greenish irroration; a larger spot on costa before apex giving off a fine obscure sharply dentate line to tornus; a fine dark-fuscous terminal line; cilia whitish obscurely barred with brownish. Hindwings with termen rounded; whitish, veins slenderly fuscous; towards apex and tornus reddish-tinged; a fine dark-fuscous terminal line; cilia whitish, with a dull reddish median line from apex.

Type in Coll. Turner.

N.Q., Kuranda; in March; one specimen received from Mr. F. P. Dodd.

*EPIPASCHIA LYGROPA*, *n. sp.*

*λυγρωπος*, gloomy-looking.

♂ 30 mm. Head ochreous-whitish. Palpi, dark-fuscous. Antennae dark fuscous; in ♂ slightly dentate, shortly ciliated ( $\frac{1}{2}$ ). Thorax and abdomen ochreous-whitish, mixed with dark-fuscous. Legs dark-fuscous irrorated and tarsi annulated with ochreous-whitish. Forewings narrow triangular, costa gently arched, apex rounded, termen bowed, oblique; ochreous-whitish densely irrorated with dark-fuscous; darker at base costa, and towards apex; a dark-fuscous sharply dentate line from  $\frac{2}{3}$  costa obliquely outwards to mid-disc, then bent inwards and continued obscurely towards mid-dorsum; a terminal series of ochreous-whitish dots; cilia ochreous-whitish barred with dark-fuscous. Hindwings with termen rounded; ochreous-whitish with a broad fuscous terminal band; cilia ochreous-whitish, with a dark-fuscous median line obsolete towards tornus. Underside with broad fuscous terminal band on both wings.

Type in Coll. Turner.

Q., Toowoomba, in November ; one specimen.

ORTHAGA MNESIBRYA.

Q., Stradbroke Island, in December ; one specimen.

ORTHAGA PERCNODES, *n. sp.*

περικνωδης, dark, dusky.

♂ 33 m m. Head and palpi brown. Antennae brown ; in ♂ with fine ciliations (1). Thorax brown ; patagia except apices blackish. Abdomen blackish above with reddish brown irroration. Legs reddish-brown, mixed with whitish and dark fuscous ; anterior pair darker. Forewings triangular, costa at first straight, rather strongly arched towards apex, apex rounded, termen bowed, oblique ; glossy brown with some dark-fuscous scales ; a large blackish spot on base of dorsum ; an interrupted blackish line at  $\frac{1}{4}$  dilated on dorsum ; two raised dark-fuscous dots in disc beneath costa before and after middle ; a fuscous dot on  $\frac{2}{3}$  costa, followed by a whitish dot, and giving off a slender fuscous line at first outwardly and then inwardly curved, but indistinct towards dorsum ; cilia brownish obscurely barred with fuscous. Hindwings with termen rounded ; fuscous ; cilia pale brownish obscurely barred with fuscous.

Type in Coll. Lyell.

N.Q., Kuranda, in May ; one specimen received from Mr. F. P. Dodd.



# THE BOTANY OF IRVINEBANK AND ITS IMMEDIATE NEIGHBOURHOOD.

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**By F. BENNETT.**

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*Read before the Royal Society of Queensland, 19th November, 1904.*

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BEARING in mind the latitude, the elevation, the mineral nature of the rocks, and the heavy tropical wet season, the botanist can guess the effect on the vegetation of the place.

The country as a whole is rugged and mountainous. There is little good soil, except in the clefts and hollows on the hill sides. Even the flats along the creeks have a substratum of weathered and water worn stones and pebbles. From December to May, owing to the heavy wet season, vegetation thrives especially where any soil is found, but with the cessation of the rains and the approach of winter with a subsequent 3 months of hot, dry weather, the herbage and grass die off and the bare, brown rocky hills have little about them picturesque or beautiful. The lush grass forced by the wet season is deficient in solid nutriment or fattening qualities and when dead and dry does not offer through the winter that sustenance afforded to stock in West Queensland by the dryest of dead grass and herbage. This with the rocky nature of the land makes it no place for the farmer or the squatter.

The vegetation is not so tropical as the latitude might lead one to suppose. This elevated and rocky region does not favour the growth of the screw pines so common on northern waters, nor are there the thick scrubs, palms, ferns, orchids, climbers, and epiphytes of the coastal ranges. The local flora presents in no respect a tropical appearance.

■

I shall refrain from repeating a long and uninteresting list of names, but shall content myself with naming the prevalent and interesting plants. For the last seven years I have been forwarding to our estimable Colonial Botanist, Mr. F. M. Bailey, such plants as from time to time I have thought judicious: I must here express my thanks to him for his unfailing courtesy, help, and forbearance, even under circumstances somewhat discouraging and trying. The district on the whole does not present much variety, most of the plants belonging to relatively few species. *Panicum nematostachyum*, *Bail.*, is a new grass discovered by myself, and *Hibbertia Bennettii*, *Bail.*, was named after the writer, who was first to bring this dangerous plant to the notice of scientists. The fact that only 2 new plants have rewarded 7 years of work is significant. The tropical coast scrubs would probably yield the collector more new species in a single month, but when the climatic conditions are considered this is hardly to be wondered at.

The general nature of the trees at least seems to vary with the soil. The stanniferous chlorite rock produces a red soil, which, where sufficiently deep and weathered down, is favourable to vegetation producing trees of great size. The bloodwood, the spotted gum, an unnamed *Eucalypt* and *Grevillea gibbosa* grow freely.

The bloodwood here is of a large size and very solid. Owing to its plentiful sap it is very useful in "wet ground," where no great cross-strain is probable.

The spotted gum is undoubtedly the monarch of the ranges so far as size is concerned. It is of the citron-scented variety, and that oil could be extracted from it at a commercial profit. The tree is very tall, straight, clean-barked and solid. The foliage is not dense, and the leaves being narrow and long, the whole tree has a light, airy, elegant appearance. Being very strong, it is excellent for timbering shafts, drives, etc. The stringy bark, though not so large, is plentiful and strong, though more apt to be hollow.

The unnamed *Eucalypt* is locally misnamed "Dead Finish," but the true Dead Finish is an *Abbizzia*, a small tree. This *Eucalypt* has a wood like yellow-box, hard, brittle, and good for firewood. The tree has the general appearance of gum-topped box, from which it differs in growing on ranges,

not on wet land. Being usually hollow when large, this tree is not so useful for timbering mines. The Eucalypts, Wattles and Beefwoods (*Proteaceae*) are well represented. The stringybark seems to select the highest peaks only, as its haunt. The other Eucalypts can descend lower.

Granite ridges, on the other hand, yield a barren soil, and do not favour herbage or trees. A worthless stunted broad-leaved iron bark grows on these hills. It is generally dead at the extremities of the branches. The difference in vegetation between the large trees of the chlorite country and the stunted trees and scanty herbage of the bare granite ridges can be seen miles away, and is very useful to the prospector.

On the ridges we find *Polycarpœa spirostyles*, *Gastrolobium grandiflorum*, *Helichrysum collinum* and *H. apiculatum*, *Hibbertia Bennettii*, *Hæmadorum coccineum*, *Dianella lævis*, *Dianella cærulea*, the lovely *Thysanotus tuberosus* or Pride of Australia, and among grasses—*Arundinella nepalensis*, *Andropogon bombycinus* and *Anthistiria ciliata*. The first-named is *the* prevailing grass on the ridges. *Acacia humifusa*, *Zamias* and grass trees also grow on the ridges.

Such grasses as *Anthistiria ciliata*, *Andropogon bombycinus*, *Heteropogon contortus* grow somewhat more luxuriantly in the clefts on the hill-sides, but *Arundinella nepalensis* asks less soil than these. These hill-side gullies show also *Lamprolobium fruticosum*, *Celospermum reticulatum* and the lovely little grass *Perotis rara*.

The creek-beds show white gum, the Shea-oak, *Tristania suaveolens* (blooming a month earlier than further south) *Acacia Simsii* and the characteristic *Timonius Rumphii*. *Tagetes patula* grows wild here, as an escaped stray. The narrow alluvial flats along the creeks show the elegant *Bursaria spinosa* (prickly box), *Careya australis* with its singular long-styled sappy fruit, *Dodonæa triquetra* (a hop-bush), *Erythrophloeum Labouchei* (ironwood), *Acacia Bidwillii*, *Persoonia falcata* (geebung), *Grevillea striata*, *Hakea Persiehana* (very like the western needlewood), *Petalostigma quadriloculare*, *Xerotes*, and among other grasses *Setaria glauca* (Foxtail grass), the fragrant *Elionurus citreus*, and *Eragrostis Brownii*, *Euphorbia pilulifera* (useful for asthma) may be seen, and as

will be noticed, the Beefwoods (Proteaceæ) are well represented. On the small open plain near the Picnic Hotel, 2½ miles west of Irvinebank, are a few of *Spondias pleiogyna* (Burdekin plum), *Santalum*, *Erythrophloeum Laboucherii*, and among grasses *Setaria glauca* and *Elionurus citreus*.

On the Bedlog gully are *Careya australis*, *Acacia trineura*, *Acacia aulacocarpa*, and *Heteropogon contortus*.

The district has rather more than the usual share of poisonous plants, and it is a matter for congratulation that, owing to the nature of the district, stock is not plentiful.

*Gastrolobium grandiflorum*, so prevalent in Western Australia, is found here, and is very poisonous. It grows even on the sides of the more barren ridges. *Lamprolobium fruticosum*, which frequents the mountain gullies, is poisonous, though it is not so notorious.

*Erythrophloeum Laboucherii*, the ironwood, is so called from the excessively hard nature of its wood, which blunts the sharpest axe. It has proved most disastrous to the camels, which were imported here to carry copper matte from Mt. Garnett. The tree, when well grown, is often over 15 inches in diameter.

Last comes *Hibbertia Bennettii*, which is named after the writer, who first brought it into the notice, at least of the scientific world. How it had escaped notice before is remarkable, as it is both wide-spread and notorious in the North. Though its poisonous properties are matters of common knowledge among the residents, no one seems to have drawn the attention of the scientific world to it before. It is a yellow flower like a buttercup, and grows on a low herb. Stock eat it with the grass it grows amongst. It is said to be the most rapid and fatal of all local poisonous plants, and, though, from humanitarian motives, I have been loth to test it on any herbivorous animal, there seems, from the unanimity of the residents, little doubt that it is highly toxic.

The principal climbers are *Tecoma australis* (said to poison stock, but this is doubtful) and *Loranthi* of several species, *Loranthus longifolius*, var. *amplexifolius* being very beautiful when in full bloom.

The prevalent grass is *Arundinella nepalensis*. The Blue and Mitchell grasses are absent, and the grasses, as a

whole, are not of much value as fodder, being of a poor class and lush in growth. A new grass *Panicum nematostachyum* has been discovered by myself.

The native names of plants differ from those given elsewhere—some dialects more resembling that of the distant Warrego district rather than that of tribes only 20 miles away on the eastern watershed.

*Capparis spinosa* is Ah dūm'.

*Careya australis* is Yuh cos' lah.

*Persoonia falcata* (geebung) is Aal por'ah.

*Breynia oblongifolia* is 'Nyell'um.

*Petalostigma quadriloculare* is Pwee.

With regard to the so-called "Copper plant," *Polycarpœa spirostyles*, brought into scientific prominence by Mr. Skertchley, where there is copper, there may be this plant, but the converse is most certainly not true.

On a ridge to the east of the Main Range, I was one day surprised to discover a hill-side clothed with *Syncarpias*. I have seen them, so far, nowhere else. The ridge lies open to the east winds from the coast, but I could find none on any other ridge opening in any eastern or other direction.

The find is not far from the Dargui mine. *Passiflora foetida*, judging by local indications is indigenous, not introduced. I have seen one Moreton Bay Ash, and only one, here.

To sum up briefly.

The flora of the district can be at once distinguished from that of Southern Queensland by the presence of such plants as *Careya australis*. This, with *Grevillea gibbosa* would at once attract notice, but apart from this, there are few plants specially local or tropical, and, with the exceptions named, the botanist, beholding the shea-oak, the spotted gum and the bloodwood in such abundance, would not be struck by anything novel. There are no scrubs of thickly clustered low-set trees like the brigalow of the Dawson and the Moonie, the mulga of the Warrego, or the gidya of the Diamantina. The "sandalwood," so cosmopolitan in its nature, is absent. The ridges, even when heavily timbered with big trees, are never thickly timbered, and never approach to true mountain scrub, nor ever show the dense vegetation so characteristic of the ranges nearer the coast, though the rainfall is almost as copious, and the



chlorite soil fairly rich. Nothing, however, is to be seen like the Kuranda scrubs, or the timber on the Atherton basalt, and cedar on the ranges is unknown.

I append, in botanical order, a list of some of the plants more common here.

Capparidæ	Passifloræ
Capparis spinosa	Passiflora foetida
Violariæ	Rubiaceæ
Ionidium suffruticosum	Timonius Rumphii
Caryophyllæ	Cœlospermum reticulatum
Polycarpæa spirostyles	Compositæ
Tiliacæ	Pluchea indica
Grewia latifolia	Helichrysum collinum
Burseracæ	"  apiculatum
Canarium australasicum	Tagetes patula
Celastrinæ	Emilia purpurea
Celastrus Cunninghamii	Apocynacæ
Siphonodon pendulum	Alyxia spicata
Sapindacæ	Loganiacæ
Atalaya variifolia	Mitrasacme polymorpha
Dodonæa triquetra	"  clata
Anacardiaceæ	Scrophularinæ
Euroschinus falcatus	Buchnera linearis
var. angustifolius	Bignoniaceæ
Spondias pleiogyna	Tecoma australis
Leguminosæ	Acanthaceæ
Gastrolobium grandiflorum	Justicia notha
Bossiaea phylloclada	Proteacæ
Crotalaria calycina	Persoonia falcata
Crotalaria trifoliastrium	Grevillea longistyla
Indigofera pratensis	"  striata
Lamprolobium fruticosum	"  gibbosa
Atylosia pluriflora	"  mimosoides
Erythrophloeum Labouchei	"  oleoides
Acacia Simsii	Hakea Persiehana
"  holosericea	Thymelæacæ
"  humifusa	Pimelea punicea
"  aulacocarpa	Loranthaceæ
"  spondylophylla	Loranthus linearifolius
"  Bidwilli	Santalacæ
Myrtacæ	Santalum lanceolatum
Eucalyptus acmenioideæ	Euphorbiacæ
"  maculata var. citrio	Euphorbia pilulifera
"  dora	Phyllanthus minutiflorus
Tristania suaveolens	Breytia oblongifolia
Careya australis	Petalostigma quadriloculare
Onagraricæ	Hæmodoracæ
Epilobium junceum	Hæmadorum coccineum

## Liliaceæ

*Dianella lævis*„ *cærulea**Thysanotus tuberosus*

## Commelynaceæ

*Cartonema brachyantherum*

## Gramineæ

*Paspalum scrobiculatum**Panicum divaricatissimum*„ *sanguinale*„ *leucophœum*„ *semialatum*„ *argenteum*„ *melananthum*„ *effusum*„ *trachyrhachis**Setaria glauca**Arundinella nepalensis**Perotis rara**Imperata arundinacea**Pollinia articulata*„ *irritans*„ *fulva**Elionurus citreus**Rottboellia formosa*„ *ophiuroides**Heteropogon contortus*„ *insignis**Andropogon sericeus*„ *pertusus*„ *intermedius*„ *bombycinus*„ *schænanthus*„ *nardus* var. *grandis**Sorghum plumosum**Anthistiria ciliata**Aristida stipoides*„ *ramosa**Cynodon dactylon**Chloris pectinata*„ *divaricata**Triraphis mollis**Eragrostis Brownii*„ *var. interrupta**Ectrosia leporina* var. *micrantha*



**PROCEEDINGS**  
OF THE  
**Annual Meeting of Members,**

*HELD ON SATURDAY, 28th JANUARY, 1905.*

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The Annual Meeting of the Society was held on Saturday, 28th January, 1905.

The President (Mr. John Cameron, M.L.A.) occupied the chair.

The Minutes of the previous Annual Meeting were read and confirmed.

A Paper, entitled : " A Preliminary Revision of the Australian Thyrididæ and Pyralidæ," by Dr. A. Jefferis Turner, was laid upon the table.

The President then delivered the following Address :—

LADIES AND GENTLEMEN,—

On annual occasions such as this, it is usual that the retiring President should first place before you a brief resumé of the general directions in which, during the year, science has extended her marvellous conquests. I purpose, briefly, to group, under the various heads, what has been accomplished in these directions.

**GEOGRAPHY.**

Central Asia. Sven Hedin has proved the extraordinary fact that the great inland lake, Lob Nor, has vanished, and the waters that filled it have percolated and worked their way to a new area where a lake, Kara Koshum, has formed.

**ASTRONOMY.**

The number of planets has been brought up to 481, a remarkable illustration of the futility of looking upon the

number seven as the perfect number of the old mystics. The strange nebula round the last new star is definitely shown to be the play of light travelling across misty space.

### ZOOLOGY.

The Arab steed is proved not to be of Arabian but of North African descent, and the types of domestic horses are shown to be of several sources, mostly local in Europe.

Dr. B. A. Brusky, of Toronto, has determined to his own satisfaction, that the introduction of marsupials into Australia took place not earlier than the Tertiary period, either by way of Malaya and New Guinea, or by the hypothetical Antarctic land. He admits a difficulty in the case of carnivore marsupials. His conclusion is based on geological evidence—marsupial remains are found in Europe and America in older deposits than in Australia, but surely, till Australian deposits have been thoroughly searched, it would seem plausible that Australia was the centre from which the few outlying marsupials known elsewhere, were disseminated.

### ARCHAEOLOGY.

It has been reported that the inscriptions of the early Empires of Central America are entirely chronological, and not historical, which is disappointing, if true.

Recent researches seem to confirm the idea, long in the air, that the most ancient civilisation known—that of Babylonia, was brought in a rough state from the north east, from that little known region of the Hindoo Koosh, long since called the “*officina gentium*,” the original of nations.

### GEOLOGY.

In practical science the demonstration of the possibility of detecting the presence of ore bodies by electro magnetic waves, has been proved. Wherever an interruption of an electric current takes place a sound is produced, which can be picked up by the telephone and this principle is utilised in the method adopted, and any large body of ore can be located by the character of the sound, but it is not by this means possible to determine such minute disturbances as to show where payable gold exists in quartz reefs. For massive minerals, such as iron and lead, it is of great value.

Mr. Ball, of the Geological Survey, has confirmed the existence of true rubies in Queensland. As no single stone of

the true pigeon's blood tint, of ten carats weight, has been found in the last 20 years, this discovery suggests great possibilities.

### PHYSICS.

The utilisation of the Hertz waves for so-called wireless telegraphy has received much attention in the Russo-Japanese War. What seems to be the most important result is the impossibility of preventing the messages being read by opponents.

Scientifically the discovery of the spectrum of the radium emanation by Sir Wm. Ramsay, and the continued researches of Prof. Rutherford—a colonial—in radio-activity, have overshadowed all the work of physicists during the year.

In accordance with the announcement made, I now propose briefly to consider the results of science on the development of Commerce. Doubtless, all of you, in one way or another, have noticed that, amongst ordinary individuals, because of habitual loose methods of thought and non-concentration of observation, those individuals fail to cultivate the mental power of looking through the phenomena which make up human communal existence, and, therefore, of accurately estimating the relativity and proportion of those phenomena. In the service of general mankind this power has performed what really are miracles, but only unflagging industry in the service of science can develop it. How many persons have even the remotest conception of the tremendous part which science thus plays in the affairs of every day life. What are the affairs of every day life? To the serious part of the community, they consist of those doings, near and remote, which make up what we term "commerce," that is the inter-business relations, local or exterior, by which one and all are enabled to satisfy the demands and wants of existence. Hardly need I dwell upon the complexity of these operations; for, in speaking of commerce, I mean not merely the restless activity of the world's great markets in which the whole human race are buyers and sellers, I mean to include the myriad spheres in which human energy is everlastingly seeking for fresh conquests over time, space, and matter.

If we consider the effects of science in their relation to what ordinarily we esteem to be time, we will find that human life, by aid of science, has been tremendously length-

ened. Authoritative statistics, as compiled for life insurance societies set the limits of human existence at an average age of 42 years. We were told in the Good Book that man's life extends over three score years and ten. Consider the problem. By the time a human being is fifteen he has just begun dimly to take notice of his surroundings. On gaining his majority, he is supposed to be a man, but how many, before the age of 35, have learned to observe correctly, or to think clearly? Therefore, all that is left, according to the figures above set down, is a period of seven years, in which the greatest power of activity can be demonstrated. The French have a very trite saying that at forty a man is either a fool or a seer. This dictum was formulated in the days when science was as yet in its infancy. The effect of modern magnificent scientific achievement has been to condense into a short span of statistical existence all the possibilities of the biblical length of life.

Naturally, foremost in the category comes the development in our educational system. Formerly we were told that we went to school to learn *how* to learn. Now our children go to school to learn once and for all. In a few years they are carried through a curriculum which, half a century ago, would have qualified them for some of the highest professions of the time. Now, before a youth is 16 years of age, he must display signs of capacity for higher realms of educational advancement, or else he must fall into the sphere of manual industry. This, you will all agree, is an excellent economy, because it is a saving both to the individual and to the State. The world cannot wait. The rising generation must quickly display its capacity to keep up in the great race of existence, or else it must fall back into the less rapid avenues in which moderate ability only is required.

The same thing is observable in industrial avenues. No longer are years wasted in boys' apprenticeships. Youths are sent into factories, where Titanic agents, called steam, and electricity, do all the hard work, and in one thousandth of the time. In this way artisans become mere feeders, and where, in olden times, they would turn out only so much product, that is, capital, now they are able to turn out a correspondingly increased amount. Suppose that fifty years ago, a quiet-going bootmaker had been told that the time was coming when

one man would be able to turn out as many as fifty pairs of boots a day, he would have called for the nearest sheriff to have the informant located either in goal, or in a lunatic asylum.

I might multiply illustrations of this sort *ad nauseam*, but I feel constrained to mention the tremendous lengthening of time, that is, of course, of human existence, implied in our achievements through scientific development in travelling from place to place. Many here present can remember the day when a voyage to the old country was looked upon as a very extensive inroad on the span of existence. Now it is a mere excursion. When Puck said he would place a girdle round the earth in forty minutes, the expression was considered to be a mere fanciful flight of imagination. Yet if an ordinary business house to-day were not able to communicate with any part of the world and get a reply in somewhere about the time mentioned, there would be serious deputations to the Post-master-General. Even in ordinary civic and domestic relations this same thing manifests itself. We must needs fly on the wings of the wind in electric trams, in rapid running suburban trains, we cannot wait for a pot of beef tea to be boiled, we have a herd of bullocks stored in our pantry in small pots ; indeed, when we come to think of it, the only marvel is that our watches and clocks have not informed the sun, to use an expression of vulgarity, "that he is too slow to get out the road of his own shadow." Philosophically, these developments are merely manifestations of the subjugation of natural forces, consequent on man's restless activity to overcome the most occult secrets of nature. To the extent above hinted, man, by the aid of science, has subjugated those forces and whilst individual researchers have emblazoned their names on the scroll of fame by their contributions to the general fund, the human race as a whole has been so much benefitted. Therefore, ladies and gentlemen, all honour to societies such as that which I now have the honour of addressing. To these pioneers in the great revolution which is bloodless, superb, and everlasting in its beneficial effects upon humanity as a whole, from the highest to the lowest in the scale of existence.

Already I have outlined some of the more important achievements which science has made in regard to space, perhaps the most important of later developments in regard to the



annihilation of space is the rapid perfection to which wireless telegraphy is being brought. When we consider that space is of no importance in commercial relations excepting in so far as it separates communication, the tremendous importance of wireless telegraphy becomes apparent. Under the old system of sending electrical messages by wire, the undertaking was one of extreme difficulty, not to mention the expense incidental. By the system of wireless transmission, the ends of the earth will be brought cheek by jowl, so that the furthest parts of the world will be nearest to whomsoever desires to have it brought on to his own office table. Hardly at this stage can we fully estimate, much less appreciate, the tremendous change which this scientific developement will bring about. It was thought when steam practically reduced miles to inches, and when later, to that swift fellow, electricity was given a position in our post offices, that the end of possibility had been reached. If we are to believe aright, the end of that possibility now is farther off than ever it was. Aerial locomotion will be an accomplished fact doubtless in our time. In a thousand cities, in obscure laboratories the midnight oil is burning, ardent devotees at the shrine of science are at this very moment, patiently, indefatigably, restlessly, and unostentatiously pursuing their worship. The reward they may never reach. They are doing it in the great cause of a great power, yet one and all are contributing to the more effective carrying out of this tremendously complex system which we call commerce. By their efforts they are cheapening the food for the poor, the advantages of education, the extent of human enjoyment; they are making easier the way towards that high ideality, that Utopia, of which the world's most enthusiastic philanthropists have reverently dreamed.

But marvellous as have been the conquests of science over time and space, they fade almost into insignificance in comparison with her conquests over that most stubborn of all elements, matter. Hardly need I dwell at any length on this particular portion of my subject. It is well known that in the largest paper factories of the continent, a tree trunk enters a machine at one end and comes out rolls of paper at the other. Look at the almost incredible advancement made in other processes of manufacture; in every department of industry, primary and secondary; in the treatment of ores; in the

treatment of all those commodities which are the primary base of the secondary manufactures. The application of science to these things has made the output so enormous that the incredible labour said to have been incurred in the erection of the Pyramids, if conducted under modern scientific conditions, could have effected the same object in a few paltry weeks. The more we consider this thing, and the more we go into details, the more astounded do we become at the results revealed, but I do not intend to take you over the whole field of scientific achievements as embodied in modern commercial developments. I have endeavoured merely to give you some brief outline of results to date, of their incalculable effects on human progress and happiness, and their still further incalculable aid in developing the human race. That development is covered by the generic term commerce. Our social existence is very bare, very meagre, it is a mere cornice round the great temple of commerce. Yet it is true that even in our social relation, this pert miss, science, will poke her busybody nose. She is ready to help us all; the palace and the mansion are literal repositories of her gallant doings. In every direction she puts nature to confusion, not only can she imitate, but she can even outdo her natural mother. Little indeed do the gay denizens of the fashionable ballroom understand to what extent the laborious researches of unostentatious students have contributed, and still are contributing to their life and enjoyment. From the perfume which exhales from the handkerchief of the coquette, to the silent electric fan which is agitating the bosom of the atmosphere, causing mimic gales to flood the room, all is the result of science.

You will agree that I have taken you over a fairly comprehensive field, yet all the matters upon which I have touched really go to make up that great thing which we call commerce. Ordinarily, we are disposed to consider commerce as the mere huxtering which goes on between buyer and seller, without any relation to the tremendous forces which enable those two interesting individuals to carry on their operations. In the lengthening of time, and, as we all know, time is money, science by so much has added to the potentiality of that invaluable element. Therefore it has enabled the science of commerce to be carried on in a much more effective and compre-

hensive manner, lessening difficulties, and in every way, contributing to the smoothness of the operation. In the comparative annihilation of space, science has brought the tropics within the arctic zone, and has transferred the arctic zone into the tropics. Little do we, on a sweltering summer day, appreciate the blessing of having portion of a southern iceberg stowed in our ice chests, with which to cool ourselves ; and whilst we are cooling ourselves, science, like a naughty little child is poking out its tongue at nature, and at her imperious limitations. In short, the more we consider all those things which make up the sum of communal modern existence, the more we perceive that it is a junction of indescribable forces with science at the head. Science, it is, therefore, which has brought our commerce to its present almost incredible condition of development. Yet I regret to say, that in the science of Government we have not gone ahead so rapidly as we might wish.

As one whose life has been passed amid the hurly burly of strenuous intercommercial existence, hardly need I say that my appreciation of the quiet achievements of a Society such as this is most keen. There are hundreds, nay, thousands of such Societies throughout the civilised world. Everyone of them, like ourselves, is steadily working towards the one great end in the service of universal mankind.

Little drops of water,  
Little grains of sand,  
Make the mighty ocean,  
And the wondrous land.

Science despises not the smallest contribution. The meanest rivulet that brings down a few golden grains to her profound ocean of knowledge is ever welcome. Had it not been for societies of this description I had not been able to make a review such as that which to-night I have feebly attempted to place before you.

In retiring from the Presidency of this Society, I am relinquishing what to me has been a labour of love, I trust that the future of this Society will be one of widely extended influence, leading up to the development of our national genius, in the direction of furthering the exploiting of the inexhaustible secrets with science still holds for the daring and the ambitious, and thereby perfecting the methods by which mankind carry on this wondrous complexity called commerce.

And in this connection I would like to say that I consider the Government of this State is adopting a very short-sighted policy in the retrenchment of Mr. De Vis. It is largely owing to his patient, unostentatious assiduity that Brisbane to-day possesses a Museum of which it will always be proud, and while it may be true that Mr. De Vis has passed the age limit of usefulness generally recognised by the Government, yet there are exceptions to every rule and this is one of them, because in scientific knowledge of the nature possessed by Mr. De Vis it is age and experience that is required, and I am sure I am expressing the feelings of the members of this Society when I say I trust the Government will seriously consider their decision on the matter.

A vote of thanks to the retiring President for his Address was carried by acclamation. The election of Office-bearers for the year 1905 then took place, with the following result:—*President*, J. Brownlie Henderson, F.I.C ; *Vice-President*, B. Dunstan, F.G.S. ; *Hon. Treasurer*, Hon. A. Norton, M.L.C. ; *Hon. Secretary*, J. F. Bailey ; *Hon. Librarian*, Rowland Illidge ; *Members of Council*: W. J. Byram, J. Cameron, M.L.A., C. J. Pound, J. Shirley, B.Sc., John Thomson, M.B. ; *Hon. Auditor*, George Watkins.

The proceedings then terminated.

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# THE ROYAL SOCIETY OF QUEENSLAND.

## FINANCIAL STATEMENT for the Year 1904.

Dr.

Cr.

RECEIPTS.		DISBURSEMENTS.	
	£ s. d.		£ s. d.
Balance from last Report	.. 143 3 4	Postage and Petty Cash	.. 11 5 5
Subscriptions	.. 16 16 0	Cash in hand	.. 0 4 7
Sale of "Proceedings"	.. 5 12 6		
		International Catalogue of Scientific Literature	11 10 0
		Advertising	22 17 7
		Printing	5 15 6
		Insurance	81 6 8
		Rent	1 2 6
		Lantern	12 0 0
		Illustrating Lecture (December)	1 7 6
		Bank Charge	1 0 0
		Balance at Bank, per pass-book	0 10 0
			28 2 1
	<u>£165 11 10</u>		<u>£165 11 10</u>

Liabilities.—Printing, £1 2s. 6d.

Examined and found correct,

ALEX. J. TURNER, F.I.A.V., Auditor.

Brisbane, 9th January, 1905.

A. NORTON, Hon. Treasurer.

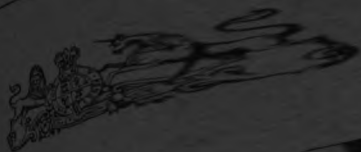




SEP 7

1906

10,129



PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND

VOLUME  
PART

II. XIX.

PRINTED FOR THE SOCIETY BY  
H. POLE & Co., PRINTERS,  
ELIZABETH STREET, B.  
1906.







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**VOLUME XIX.**  
**PART II.**

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**1908.**



THE  
**Royal Society of Queensland.**

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HIS EXCELLENCY MAJOR-GENERAL SIR HERBERT  
C. CHERMSIDE, G.C.M.G., C.B.

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## CONTENTS.

<b>A DISEASE GARDEN.</b> — <i>John Thomson, M.B.,</i> May 27th, 1905	...	...	...	<b>PAGE</b>  <b>78</b>
<b>A PRELIMINARY REVISION OF THE AUSTRALIAN THYRIDIDAE AND PYRALIDAE</b> (PART II.—continued)— <i>A. Jefferis Turner, M.D.,</i> <i>F.E.S.,</i> January 2nd, 1905	...	...	...	<b>89</b>
<b>NOTES OF TRAVEL. BRISBANE TO PORT CURTIS BY</b> <b>LAND IN 1861.</b> — <i>Hon. A. Norton, M.L.C.,</i> July 21st, 1904	...	...	...	<b>91</b>
<b>DESCRIPTION OF A TYPICAL QUEENSLAND</b> <b>LAGOON (THE ENOGGERA RESERVOIR, NEAR</b> <b>BRISBANE)—WITH METHODS OF RENDERING THE</b> <b>WATER FIT FOR A TOWN SUPPLY.</b> — <i>Hardolph</i> <i>Wastenhys, Analyst to Brisbane Board of Water-</i> <i>works,</i> August 5th, 1905	...	...	...	<b>105</b>
<b>PRESIDENTIAL ADDRESS</b>	...	...	...	<b>iv.</b>

# A DISEASE GARDEN.

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By **JOHN THOMSON, M.B.**

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*Read before the Royal Society of Queensland, 27th May, 1905.*

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IN Queensland there is a *Local Authorities Act*, and the people enjoy the privilege—if there be any—of Local Government, and, of course, they have to pay for this ; but, whether they get the value of their money is quite another matter.

Under heavy penalties they have to keep their allotments and their lands free from certain weeds and plants declared to be *noxious* and a nuisance. I presume they are so declared because, at present, they serve no economic purpose. Anyhow, the ratepayers have to destroy these pests, and I think I may safely say—they don't.

The Brisbane By-laws of the *Local Authorities Act* mention some thirty-two of these *Noxious Weeds*, and lest there be any mistake, refer to them in the vulgar and in the classic tongues.

Undoubtedly, these apparently useless samples of vegetable life are a nuisance, and to let them take root and spread is simply to let them take possession of the land, and rob the human owners.

But noxious as these weeds may be, they are harmless, in comparison with other weeds which are responsible for an immensity of the disease which attacks and slays mankind, and to combat these enemies, another act—*The Health Act*—operates, and like the *Local Authorities Act*, it advertises a

list of noxious plants by indicating the diseases they give rise to—diseases due to vegetable organisms and known as infectious.

**“Infectious Disease.”**—Bubonic or Oriental plague, smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlatina, scarlet fever, the fevers known by any of the following names—typhus, typhoid, enteric, relapsing, continued or puerperal, and also any other disease which the Governor-in-Council, on the recommendation of the Commissioner, and from time to time by notification in the *Gazette*, brings under the provisions of this Act, either generally or with respect to any particular place.

And it is the duty of the Health Authorities administering the Act, if possible, to destroy, or as it is called stamp-out these infections.

The terms, **Infection, Infectious and Infective** refer only to those diseases which are caused by pathogenic (disease producing) germs, which enter into the tissues from without, and are capable of multiplying in the same.—*Kanthack*.

**Contagion, Contagium, Contact, Contagious,** refer to Infectious Diseases which are communicated directly from one person to another.—*Osler*.

“Infection includes contagion.”—*Kanthack*.

The word germ, having been associated with disease, introduces us to :—

**The Germ Theory of Disease** which teaches :—that certain ailments are due to the action of certain germs. To extend this :—that, in man and animals, certain Diseases—which may be local, or general, or both ; acute (hours) or chronic (years) ; mild, or almost certainly fatal, and whose chief lesions or symptoms are due to poisonous effects (*intoxicants, toxins*) and mechanical interference—are dependent upon the presence, multiplication and conduct in the blood, lymph or tissues of the affected individual of a minute organism (*Germ*) which requires an *Incubation Period* of varying length, for the first manifestations of its existence.

The natural question now is—“How can this be proved ?” or “On what foundation is this theory raised ?” Professor Robert Koch, he, who, in 1882, made himself and the year

famous by discovering the *Tubercle Bacillus*—the germ of consumption—provides the answer by insisting that certain postulates must be proven before a micro-organism can be accepted as the author of any particular ailment.

1. The micro-organism must be found in the blood, lymph, or diseased tissue of the man or animal suffering from, or dead of, the disease.

2. The micro-organism must be isolated from these media, and artificially cultivated outside the animal body, and these cultivations must be carried on through successive generations, and the purity of them maintained.

3. The micro-organism thus obtained, after generations of pure culture, must, when introduced into the body of a healthy animal, capable of taking the disease, produce the disease in question.

4. The micro-organism must be again found in the inoculated animal, and in greater number, showing it has proliferated.

And quite a number of diseases, from about twenty-seven to thirty, have complied with the requirements, and are accepted as of established Bacteriology.

The term **Bacteriology** includes much more than the derivation of the word warrants. It should refer only to the study of *Bacteria*—vegetable micro-organisms—but usage and consent include in it *all* the morbidiferous germs, and some of these belong to the *Protozoa*—to animal life.

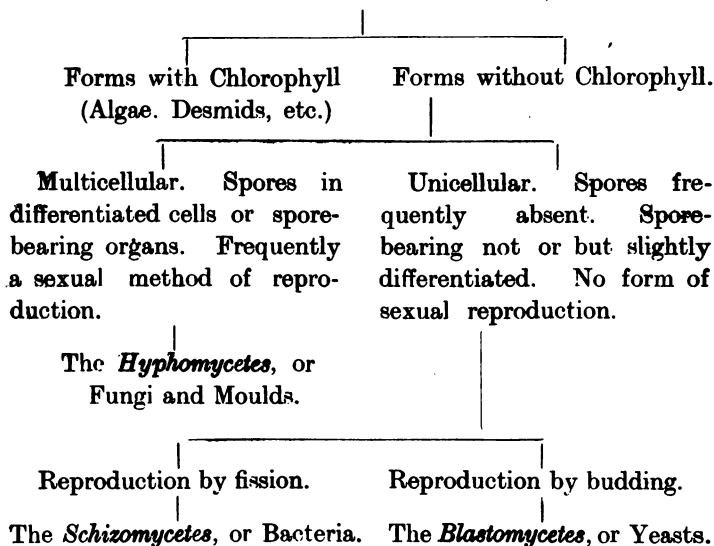
**Bacteria** are unicellular vegetable growths, devoid of chlorophyll, and multiplying by cleavage—fission—hence the more scientific name—*Schizomycetes* or *Fission-fungi*.

They can be cultivated much as the plants in a garden, and under favourable conditions—of suitable soil, nutrient medium, as it is called; moisture; temperature; light or darkness; oxygen (air) or the want of it—can be made to flourish luxuriantly; yield brilliant colours; emit odours, never fragrant odours, usually stench most abominably objectionable and generate deadly poisons.



Their place in the vegetable world is indicated by the following scheme :—

*Thallophyta* (lower plants without fibro-vascular bundles, and with no distinction between root and stem).



**Bacterial classification** is incomplete and unsatisfactory. Each author has formulated or favoured some scheme of his own, but none has been generally adopted. Our knowledge is still limited, and many factors have to be considered ; the lines, upon which attempts to classify have been made, are shown in following table from Gould and Pile's Dictionary.

### CLASSIFICATION.

- |                                   |   |                    |            |
|-----------------------------------|---|--------------------|------------|
| 1.—According to morphology, . . . | { | 1. Microbacteria—  | } Bacilli. |
|                                   |   | short rods.        |            |
|                                   |   | 2. Desmobacteria—  |            |
|                                   |   | long rods.         |            |
| 2.—According to biology, . . .    | { | 3. Spherobacteria— |            |
|                                   |   | globules.          |            |
|                                   |   | 4. Spirobacteria—  |            |
| 3.—According to necessary medium, | { | 1. Saprophytic.    |            |
|                                   |   | 2. Parasitic.      |            |
|                                   | { | 1. Aerobic.        |            |
|                                   |   | 2. Anaerobic.      |            |

CLASSIFICATION.—*Continued.*

- |  |   |                     |
|--|---|---------------------|
| 4.—According to virulence, . . .                       | { | 1. Pathogenic.      |
|  |   | 2. Nonpathogenic.   |
| 5.—According to manner of division, . . . . .          | { | 1. Diplococci.      |
|  |   | 2. Streptococci.    |
|  |   | 3. Staphylococci.   |
|  |   | 4. Leptothrix, etc. |
| 6.—According to sporulation, . .                       | { | 1. Endospore.       |
|  |   | 2. Arthrospore.     |
| 7.—According to colour, . . . .                        | { | 1. Chromogenic.     |
|  |   | 2. Nonchromogenic.  |
| 8.—Bacteria that contain no chlorophyll (fungi), . . . | { | 1. Hyphomycetes.    |
|  |   | 2. Saccharomycetes. |
|  |   | 3. Schizomycetes.   |

The simplest classification is that based upon (1) **morphological characteristics**—that is, shape and form, and (5) the **manner of division**.

I.—**Cocci**—round, spherical or oval cells, which always retain their shape, no matter in what natural or artificial media they may grow.

1. *Monococci*—single forms.
2. *Diplococci*—when the cells are in pairs.
3. *Tetrads*—when the cells divide in two directions on the same plane, forming squares.
4. *Sarcinae*—when the cells divide in three directions on different planes, forming cubes.
5. *Streptococci*—when the cells are arranged in chains or beads.
6. *Staphylococci*—when the cells are in irregular clumps or bunches, like bunches of grapes.
7. *Zooglæa*—when the cells are embedded in their own glutinous secretions.

II.—**Bacilli**—rod like structures in which the greater diameter is more than twice the lesser. They may be long and thin ; or plump and almost round ; they may have square, pointed, round or clubbed ends, and they may arrange themselves in pairs, chains, clumps or filaments. They may be rigid or flexible ; motile or non-motile.

III.—**Spirilla**—Rods having a curved or spiral form.

1. *Spirochaete*.
2. *Vibrios*.

#### IV.—Higher Bacteria—

1. *Clostridia*—when the rods are fusiform or spindle-shaped.
2. *Cladothrix*—when the rods are in filamentous forms, with pseudo branches and true spores.
3. *Lepothrix*—when the rods are of great length, straight, but with no spores.
4. *Streptothrix*—when the rods truly branch with occasional club-shaped thickenings.

Classification according to (2) **biology**.

I.—**Saprophytes**—organisms which grow on, or in decaying organic matter and can exist independently of a living host.

II.—**Parasites**—organisms which are unable to exist without a living host—plant or animal.

Organisms strictly saprophytic or strictly parasitic, are called *Obligate*; while those organisms, which, being saprophytic, may become parasitic, and *vice versa*, are known as *Facultative*.

Classification according to (3) **necessary medium**—the necessity for pure oxygen or air.

I.—**Aerobic**—organisms which grow only in the presence of free oxygen or air. When this is absolutely essential, when they are *obliged* to have oxygen for their existence they are called *Obligate or Obligatory Aerobes*; but when they become amphibious as to the oxygen, that is live with it or under favourable circumstances, without it, through some acquired *faculty* they are known as *Facultative Aerobes*.

II.—**Anaerobic**—organisms which grow without the presence of free oxygen or air; they can appropriate oxygen from the unstable organic compounds on, or in which they live and among them, both *Obligate* and *Facultative* varieties, are to be found.

Classification according to (6) **sporulation** :—

I.—**Endospores** are usually found in the Bacilli or rod-shaped organisms, and are refractile bodies in the interior of the rods. They are highly resistant to the action of light, heat and disinfectants.

They vary in size and shape, being round, or oval or rod like; they also vary in position, being sometimes central,

sometimes at one end, but they are always constant for the same species.

There is rarely more than one spore in a bacillus, and each spore, under favourable conditions, produces only one parent form.

Muir and Ritchie say "sporulation is to be looked upon as a resting place of a bacterium, and is rarely, if ever, to be considered as a method of multiplication."

II.—**Arthrospores** are spores formed by joints, and about the existence of these there seems to be a considerable element of uncertainty.

Classification according to (4) **virulence** and (7) **colour** may be grouped, together with the conditions the Bacteria give rise to, or the changes they effect, in the media in which they grow.

- |                           |                                  |
|---------------------------|----------------------------------|
| I.— <b>Zymogenic</b> —    | Ferment producing                |
| II.— <b>Pathogenic</b> —  | Disease producing                |
| III.— <b>Saprogenic</b> — | Putrification producing          |
| IV.— <b>Chromogenic</b> — | Colour producing                 |
| V.— <b>Photogenic</b> —   | Light—phosphorescence—producing. |

Some micro-organisms are *flagellated*, that is. they have long, slender, lash-like appendages; and the motility which some of these organs enjoy is supposed to be due to their flagella.

When there is but one flagellum, the organism is said to be *monotrichic*; when the flagella surround the organism, it is called *peritrichic*, and when the flagella are tufted or in clumps, the term *lophotrichic* is used.

Many organisms are *encapsuled*—surrounded by a homogeneous covering or *capsule*.

**The rate of Multiplication among Bacteria.**—The numbers in all the classes of bacterial varieties are "as the sand which is by the sea shore, innumerable," and it is almost impossible to realise their rapidity of multiplication.

A single generation, which is to be considered as the time elapsing between two successive divisions is frequently only the fraction of an hour. In some species the individual may grow to maturity and reproduce in twenty minutes. The rate of multiplication thus becomes enormous as time goes on.

Dr. Ferdinand Cohn calculated both the rate and the weight of this multiplication and justified his computations, being far from idle play, as they made the immense work executed by the Bacteria comprehensible to us.

The following table is compiled from Cohn's calculations :

Number of Generations.	Number of Individuals.	Weight.
1	1	0.000,000,000,004,243,672 gr.
24	16,500,000	0.000,4 grain—plus
48	47,000,000,000,000	one pound—plus
78	—	825 tons
168	{ 100,000,000,000,000,000,000,000, 000,000,000,000,000,000,000, 000,000,000	A mass about the size of the world.

Fortunately for us, long before the offspring reach far into the millions, their rate of multiplication is checked either by lack of food, or by the accumulation of their own secreted products which are poisonous to them.

**Size of Bacteria.**—The standard by which this is gauged is the

### MICRON.

Unit of measure in Micrometry.

### METRE

Ten millionth (1-10,000,000th) of a quadrant of the Meridian.

39.3704 inches, or 3 feet, 3 inches and 3 eighths.

### Centimetre, c.m.

0.01 or 1-100th of a metre.

0.393,7 or 2-5ths (nearly) of an inch.

### Millimetre, m.m.

0.001 or 1-1000th of a metre.

0.039,37 or 1-25th (nearly) of an inch.

### MICRON, plural *microns*, *micra*, symbol, $\mu$

0.001 or 1-1000th of a millimetre.

0.000,001 or 1-1,000,000th of a metre.

0.000,039,37 or 1-25,400th of an inch

**INCH.**

1 inch equals	2.54	centimetres.
1 „ „	25.4	millimetres.
1 „ „	25,400	micra, $\mu$

Small as the *micron* is, there are many objects constantly under microscopical observation, which are but fractional parts of it. And in the calculation of ethereal wave lengths, this microscopic *micron* is again divided into thousand and million parts.

Some of the micrococci are so small that four of them can be easily packed into a square *micron*; most of the bacilli are but half a *micron* broad, while there may be one, two, three or more *micra* long; and some of the stained flagella are but fractional parts of a *micron* or less than the 1-100,000th of an inch.

With few exceptions, the slides exhibited have been photographed at a magnification of 1000 diameters—that is linear—or 1,000,000 superficial. And this magnification is guaranteed, for the microscopical and photographic apparatus were adjusted and standardised after careful experimenting with stage micrometers.

In the slides or photo micrographs, the size of any micro-organism can be determined at a glance, for a graphic plan has been adopted of having a scale, occupying half the picture, printed on the transparency along with the micro-organism.

Each small square of the scale, represents a square **MICRON.**

**Benign, Useful, or Friendly Bacteria.**—It is rather unfortunate that the public should associate bacteria with disease—in fact view them as synonymous terms.

That we have foes—foes treacherous and implacable—amongst these tiny organisms is certain; but we have also friends, trusty and reliable, humble, perhaps, and unobtrusive, but persistingly working together for our general welfare.

**BACTERIA.**

Their use in the Arts.

**Maceration Industries.**

Linen	Hemp
Jute	Cocoa Nut Fibres
Sponges	Leather preparation
Maceration of skeletons	Citric acid

**Fermentative Industries.**

Vinegar	Indigo
Lactic Acid	Butyric acid
Tobacco curing	Opium (smoking) curing

**Dairy Industry.**

Cream ripening	Cheese ripening
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**Agriculture.**

Nitrification	Sprouting of seeds
The Silo	Fertility of the soil

**Food Products.**

Game flavour	Sauer Kraut.
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**Purification of Sewage.**

The effects of friendly bacteria are seen in the manufacture of linen, hemp and jute ; in the preparation of indigo ; the curing of opium and the production of vinegar.

The fragrance and aroma of tobacco are due to bacterial causes. Ere the tobacco leaves are fit for use, they have to go through many processes, some of which, at least, are fermentative. "The special quality of tobacco is in part dependent upon the peculiar type of fermentation that gives rise to the flavour and aroma of the tobacco, and as the number of species of bacteria which are found on the tobacco leaves, in the various stages of its preparation, is quite large, it is inevitable that the different kinds of bacteria will produce different results as to flavour and grade in the fermenting process."

The dairyman has to put up occasionally with the enmity of unfriendly bacteria ; the souring of his milk ; its somewhat bitter, tainted or soapy taste ; its blue, red, or yellow colour ; its slimy consistence are due to the growth in the milk of unusual bacteria. On the other hand, the ripening of his cream and the ripening of his cheese, giving it the special flavour, which finds acceptance in the market, are but the effects of his allies the friendly bacteria. The flavour of cheese is due to a bacterial growth of a fermentative character, giving rise to decomposition, which, in the case of Limburger and others, is not very difficult to discover.

To the agriculturalist the friendly bacteria are as essential as the soil or the seasons. It has been asserted, I don't know

how truly, that—given the choicest soil for some special crop—not a blade would grow, if all the factors—the earth, seed, water and air—had been absolutely deprived of bacterial life.

Certainly it has been proved that the complex process of *nitrification*, the process by which nitrogen from *organic* substances—decomposing animal and vegetable bodies, manures, etc.—is transformed or *mineralised* into ammonia, nitrous and nitric acids depends upon micro-organic life, and that the conversion is a double one. One set of bacteria changes the ammonia into nitrous acid, and a totally different set transforms the latter into nitric, which unites with soil ingredients to form nitrates. The process is an oxydising one, but it is a fundamental of agricultural chemistry.

As baking (*panary fermentation*) and brewing (*vinous fermentation*) are both dependent upon the behaviour of the yeast plant—of which, by-the-way, there are many varieties—and as yeasts are half brothers of the bacteria, one may truly assert that our lunch, of bread, butter, cheese, and beer, with salad and its vinegar dressing and the subsequent soothing weed, is composed of articles, whose very existence is undoubtedly dependent upon or absolutely due to micro-organic life; and, judging from the number of bacteria found in the mouth, and also from the number on the mucous surface of the *prima via*, it is at least probable, that the process of digestion is more or less dependent upon bacterial aid.

And another, a more recent, and, if successful, perhaps the most important, of all the friendly aids which man receives from lowly life is the bacterial treatment of sewage, or as it has been referred to as “simply allowing Nature to fulfil her function by means of bacteria.”

The **Pathogenic Organisms** will now claim our attention, and as these are responsible for the Infective Diseases, Kanthack's classification of the latter, as it appears in the first volume of Clifford Allbutt's *System of Medicine*, may be accepted as authoritative. And although this was published in 1896, the years since then have made but little change.

The list gives 17 diseases of more or less established bacteriology:—19 are catalogued as uncertain; 5 appear as



communicable from animals to man, and 2 are due to *Protozoa*—a total of 43 ailments.

Perhaps No. 28 *Yellow Fever* may now be included in Class IV. *Diseases due to Protozoa*. At one time *Yellow Fever* seemed to have an established bacteriology, due to Sanarelli's announcement of his discovery of its bacillus, but now its protozoal origin seems to be determined.

No. 31. *Maltese Fever* might be transferred to Class I. (a) owing to its cause, the *Micrococcus Melitensis*.

No. 33. *Negro-Lethargy*, sleeping sickness, is believed to be due to a *Trypanosome*, a *hæmatozoon*.

No. 35. *Verrugas*—Peruvian Wart—is credited as the production of the *Bacillus Yzquierdo*.

### I. Diseases of more or less established Bacteriology.

#### (a) Local or General Diseases due to Pyococci.

- (1) Septicæmia and Pyæmia
- (2) Erysipelas
- (3) Infective endocarditis
- (4) Puerperal Septic Disease
- (5) Carbuncles and Boils

#### (b) Infective Fevers

- (6) Epidemic Pneumonia
- (7) Cerebro Spinal Meningitis
- (8) Influenza
- (9) Diphtheria
- (10) Tetanus
- (11) Enteric Fever
- (12) Cholera
- (13) Oriental Plague
- (14) Relapsing Fever

#### (c) Infective Diseases of Chronic Course.

- (15) Tuberculosis
- (16) Leprosy
- (17) Actinomycosis

### II. Diseases of uncertain Bacteriology.

#### (a) Not Endemic.

- (18) Measles
- (19) Rubeola
- (20) Scarlet Fever
- (21) Varicella

- (22) Variola
- (23) Mumps
- (24) Whooping Cough
- (25) Syphilis
- (Mixed Infections.)

#### (b) Topical or Endemic. (Fevers of India).

- (26) Typhus
- (27) Dengue
- (28) Yellow Fever
- (29) Amoebic Dysentery
- (30) Beri Beri
- (31) Maltese Fever
- (32) Epidemic Dropsy
- (33) Negro Lethargy
- (34) Dehli Boil
- (35) Verrugas
- (36) Framboesia

### III. Infective Diseases communicable from Animals to Man.

#### (a) Of certain Bacteriology.

- (37) Glanders
- (38) Anthrax

#### (b) Of uncertain Bacteriology.

- (39) Vaccinia
- (40) Foot to mouth disease
- (41) Rabies

### IV. Disease due to Protozoa.

- (42) Malaria
- (43) Blackwater Fever

In the following table, the Local and General Diseases, due to *Pyococci*, mentioned in Kanthack's list, Class I (a) are given more in detail and the pus-producing organisms responsible for them, are specified.

Abcess	Hospital Gangrene
Boils	Osteo-myelitis
Carbuncles	Puerperal Fever
Cellulitis	Pyæmia
Erysipelas	Sapræmia
Endocarditis (infective)	Septicæmia
	Blennorrhagia.

**Bacteria** producing the above :—

Usual.	Occasional.
Staphylococcus pyogenes	B. Coli communis
<i>albus, aureus, citreus</i>	B. Oedematis Maligni
Streptococcus pyogenes	B. Ærogenus capsulatus
? <i>brevis, longus</i>	B. Pyocyaneus
Micrococcus tetragenus	B. Typhosus
„ of Neisser	Diplococcus Pneumoniæ
Diplococcus Intracellularis	Meningitidis.

It has been asked, Why call this lecture

### “ A Disease Garden ? ”

True, I cannot let you see the growing plants : but a visit to a Disease Garden (a bacteriological laboratory) will show you them living and being cultivated.

The pictures projected on the screen represent types of vegetable life as real as anything ever produced in a flower—a fruit—a vegetable—or a kitchen garden. These names suggest what each garden grows, and as mine yields disease producing plants, “ Why not a Disease Garden ? ”

## APPENDIX.

List of Slides (136) projected on the screen during the Lecture.

- 1 Noxious Weeds. Local Authorities Act
- 2 Infectious Disease. Health Act
- 3 Definitions. Infection and Contagion
- 4 Germ Theory of Disease
- 5 Koch's Postulates
- 6 Place of Bacteria in Vegetable Kingdom
- 7 General Classification of Bacteria
- 8 Classification according to Morphology and Division
- 9 Types of Bacteria
- 10 Classification according to Biology
- 11 " " " necessity for Air
- 12 " " " Sporulation
- 13 Types of Spores
- 14 Classification according to Virulence, Colour, etc.
- 15 Types of Flagella
- 16 Multiplication of Bacteria
- 17 The Micron
- 18 Stage Micrometer, magnified x 1000
- 19 Scale of square Micra
- 20 Bacteria, their use in the Arts
- 21 Infective Diseases
- 22 Suppuration and Septic Diseases

## Pathogenic Organisms.

					No. of specimens	Magni fication.
24	Actinomyces—Lumpy Jaw	..	..	..	1	250
25	" " "	..	..	..	1	500
26	Bacillus Aerogenes Capsulatus	..	..	..	1	1000
27	" Anthrax—cover glass impression	..	..	..	1	75
28	" " blood of mouse	..	..	..	1	250
29	" " " " "	..	..	..	2	500
30	" " spores	..	..	..	2	1000
31	" " Symptomatic—Black Leg	..	..	..	1	1000
32	" Cholera Asiatic—spirilla	..	..	..	1	1000
33	" Chicken Cholera	..	..	..	2	1000
34	" Coli Communis	..	..	..	1	1000
35	" Diphtheria	..	..	..	2	1000
36	" " "	..	..	..	1	1250
37	" Dysentery—(Shiga)	..	..	..	2	1000
38	" Glanders—Mallei	..	..	..	1	1000
39	" Icteroides—Yellow Fever—(Sanarelli)	..	..	..	1	1000
40	" Influenza	..	..	..	1	1000
41	" Leprosy	..	..	..	6	1000
42	" Malignant Edema	..	..	..	2	1000
43	" Micrococcus Tetragenus	..	..	..	2	1000

44	<b>Bacillus Plague—pestis</b>	.. .. .	6	1000
45	„ „ involution forms	.. .. .	3	1000
46	„ „ bi-polar staining	.. .. .	1	2000
47	„ Pneumonia—diplococcus	.. .. .	3	1000
48	„ Pyocyaneus—blue pus	.. .. .	1	1000
49	„ Swine Fever	.. .. .	3	1000
50	„ Tetanus	.. .. .	3	1000
51	„ „ with flagella	.. .. .	1	1000
52	„ Tubercle	.. .. .	6	1000
53	„ „ -pseudo, sheep disease	.. .. .	1	1000
54	„ „ phagocytes, frog's blood	.. .. .	1	1000
55	„ Typhoid, culture	.. .. .	1	1000
56	„ „ with flagella	.. .. .	4	1000
57	„ „ involution forms	.. .. .	2	1000
58	Gonococcus	.. .. .	4	1000
59	Staphylococcus from pus.	.. .. .	2	1000
60	„ pyogenes aureus—culture	.. .. .	1	1000
61	„ culture—malignant endocarditis	.. .. .	2	1000
62	„ „ pyæmia	.. .. .	2	1000
63	Streptococcus on epithelial cell	.. .. .	1	500
64	„ in „ „	.. .. .	1	500
65	„ from mouth	.. .. .	1	1000
66	„ from malignant diphtheria	.. .. .	1	1000
67	„ from erysipelas	.. .. .	4	1000
68	Tubercle and Leprosy—contrasted	.. .. .	1	1000
69	Tetragenus and Sarcina, „	.. .. .	1	1000
70	Plasmodium Malariae	.. .. .	1	1000
71	Pyrosoma Bigeminum - Tick Fever	.. .. .	1	500
72	Parasite—blood of snake	— .. .. .	1	1000

### Non-Pathogenic Organisms.

73	Bacillus Chromogenic agar culture..	.. .. .	1	1000
74	„ „ gelatine culture	.. .. .	1	1000
75	„ Figurans	.. .. .	1	35
76	„ „	.. .. .	1	500
77	„ „	.. .. .	1	1000
78	„ Ianthinus	.. .. .	1	1000
79	„ Indicus	.. .. .	1	1000
80	„ Megaterium	.. .. .	1	1000
81	„ Prodigiosus	.. .. .	1	1000
82	Mucor Rhizopodoformis	.. .. .	2	250
83	Oidium Lactis	.. .. .	1	20
84	„ „	.. .. .	1	500
85	Saccharomyces Cerevisiae—Beer Yeast	.. .. .	2	500
86	Sarcina Aurantiaca	.. .. .	2	1000
87	„ Lutea	.. .. .	2	1000
88	Spirillum Rubrum	.. .. .	1	1000
89	Spirochæte—culture	.. .. .	2	1000



# A PRELIMINARY REVISION OF THE AUSTRALIAN THYRIDIDAE AND PYRALIDAE.

By **A. JEFFERIS TURNER, M.D., F.E.S.**

PART II.—Continued from page 63.

## **RHODONEURA LOXOMITA, n. sp.**

*λοξομιτος*, with oblique thread or line.

♂ ♀ 24-30  $\text{mm}$ . Head and palpi dull ochreous. Antennae dull ochreous; in ♂ thickened, and with extremely short pectinations ( $\frac{1}{8}$ ). Thorax ochreous in ♀, in ♂ pale rosy, except tegulae and bases of patagia. Abdomen pale rosy in both sexes, but more distinctly in ♂. Legs ochreous, tarsi ochreous-fuscous. Forewings triangular, costa gently arched, apex pointed, termen bowed, strongly oblique; dull ochreous with darker strigulae; basal half of dorsum suffused with pale rosy; a well-marked fuscous streak from apex to dorsum at  $\frac{2}{3}$ ; cilia concolorous. Hindwings with termen rounded; color, strigulae, and cilia as forewings; a transverse fuscous streak at  $\frac{1}{3}$  continuing that of forewing; between this and base a rosy suffusion.

Type in Coll. Turner.

I formerly referred a ♀ example to *R. scitaria*, though with doubt. A second ♂ example received from Dr. E. Culpin shows it to be distinct. Independently of the rosy suffusion, which is better marked in the ♂, the forewings are narrower, more acute, with more oblique termen, and the oblique streak distinctly to apex. Brisbane and Mount Tambourine must be deleted from the localities for *scitaria*. It is impossible to say that Dr. Lucas' description of *stramentaria*, though unrecognisable, may not have been intended for this species, but, if so, it is very inexact, and the name cannot be adopted without evidence.

Q., Brisbane, Mount Tambourine, in January and April; two specimens.

MELLISSOBLAPTES CISSINOBAPHES, *n. sp.**κισσινοβαφης*, stained with ivy green.

♀ 24  $\text{M}\text{M}$ . Head and antennae ochreous-whitish. Palpi ochreous-whitish, tinged on outer surface with pale fuscous. Thorax whitish-ochreous, collar and patagia dull greenish. Abdomen ochreous. Legs ochreous-whitish; anterior and middle pairs mixed with fuscous. Forewings elongate-oval, costa strongly arched, apex round-pointed, termen obliquely rounded; ochreous-whitish, mixed with dark fuscous and reddish fuscous; in posterior part of disc the dark scales form fine lines along the veins; a large oval green suffusion on dorsum from  $\frac{1}{3}$  nearly to tornus, reaching nearly to middle of disc; a slight green suffusion at apex; a series of minute dark-fuscous dots on termen and apical  $\frac{1}{4}$  of costa; cilia ochreous-whitish with median and penultimate fuscous lines. Hindwings with termen rounded, scarcely sinuate; dull ochreous; apical  $\frac{1}{4}$  suffused with dull greenish; cilia whitish grey.

Type in Coll. Lyell.

N. Q., Kuranda; in May; one specimen received from Mr. F. P. Dodd.

## TALIS PEDIONOMA.

W.A., Bridgetown (Coll. Lyell).

TALIS ICELOMORPHA, *n. sp.**εικελομορφος*, of similar form.

♀ 24  $\text{M}\text{M}$ . Head, palpi and thorax ochreous-whitish; frontal cone well developed ( $\frac{1}{2}$ ); palpi very long (5). Antennae ochreous-whitish, towards apex grey. Abdomen whitish. Legs ochreous-whitish. Forewings elongate, costa rather strongly arched, apex tolerably acute, termen nearly straight, oblique; ochreous-whitish sparsely irrorated with large black fuscous scales; a fine indistinct median whitish streak from base to  $\frac{3}{4}$ , margined above with fuscous; a dark fuscous discal dot on lower edge of median streak shortly before end; some minute dark-fuscous terminal dots; cilia whitish. Hindwings with termen rounded, whitish; cilia whitish.

Near *acontophora* but frons with a longer cone, forewings with termen not sinuate, central streak not prolonged to termen or apex, cilia without darker line.

Type in Coll. Lyell.

W.A., Bridgetown.

## NOTES OF TRAVEL.

BRISBANE TO PORT CURTIS BY LAND IN 1861.

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By **HON. A. NORTON, M.L.C.**

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*Read before the Royal Society of Queensland, 21st July, 1904.*

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IN 1860, after three years of continuous bush travel in many parts of New South Wales, and some districts of Victoria, I found my way to the Port Curtis district of Queensland, having followed an overland route from Raymond Terrace to Gladstone. I had inspected some pastoral properties in the Lower Burnett and Port Curtis districts, with the view of purchasing, and, having made an offer for one of these, which the managing partner favoured, I took steamer (the Sampson) from Maryborough to Sydney, in March, 1861, to settle the matter one way or the other, with the senior partner. This gentleman invited me to dine with him at his very comfortable suburban residence, and we became good friends at once, but when we talked over business, we differed over about £200. Anticipating a possible failure in this case, I had arranged with its owner a price at which I could secure Rodd's Bay station, unstocked and unimproved. I wrote at once therefore accepting this offer, and determined to go without delay, and take possession. Before leaving Sydney, I purchased a draft of cattle from Bundock, Barnes and Co., on the Richmond River, to be delivered to me on Rodd's Bay. Then I put two horses I had bought on board the s.s. Eagle, and paid £5 each freight on them to Brisbane; for my own passage I was charged £8, and in due course I arrived at the metropolis of the recently separated colony. I put up at MacAdam's Hotel, a one-storied building in Queen Street, with a veranda along the front. This was Brisbane's crack hotel. This occurred in May or June.



Having completed my arrangements, I started one day for Ipswich, immediately after lunch, crossing by the punt to South Brisbane, and following the road which was then in use. There had been a heavy fall of rain just before; it was showery that afternoon, and the road was very heavy in places. Night had set in by the time I reined up at the North Australian Hotel (I think that was its name) at Ipswich; here a tragic event had happened during the afternoon. Count Hickey had started for Jinghi Jinghi, where he lived, in a buggy, accompanied by his wife, nurse, and infant child; but before he had gone far, he discovered something wrong with the harness, and turned back with the intention of having it repaired. The horses took fright, however, and got beyond control; they came to the hotel at a gallop, and, in turning the corner to their late stables, the buggy came into collision with a post, and was overturned. Count Hickey and the nurse were seriously injured, while Mrs. Hickey was killed; the child was unhurt. The accident cast a gloom over Ipswich, and this was aggravated by the rain, which came down steadily all night. The unfortunate lady, whose end had come so suddenly and so unexpectedly, was buried on the following day.

I was detained two days in Ipswich, all the watercourses being flooded, but on the third morning I made a fresh start. In close proximity to the "Modern Athens," as Sir George Bowen described Ipswich, there were a few suburban dwellings of unpretentious appearance; then came forest land, with an occasional homestead; this was the general character of the country from Ipswich to Gladstone, with homesteads in a diminishing quantity. About mid-day I struck the Brisbane River, at a station occupied by Mr. or Major North. The water was turbid, and the current too strong to be inviting; as I was unacquainted with the depth, etc., I rode up to the station, and Mr. or Major North very kindly sent his son to see me over a safer crossing, after which there was no further difficulty; so I jogged on quietly until in the afternoon I came to a fairly good bush hotel, and there I spent the night. Its name I am unable to recall, but it was the first habitation I had seen after crossing the river. On the following day, which was Saturday, I continued my journey until I arrived at Mount Brisbane, where I was very hospitably

received by the Hon. Francis Bigge, M.L.C. Mr. and Mrs. Bigge were living in their new cedar house, Mr. and Mrs. Bowman in the cottage close by, which had, until the erection of the cedar house, done duty as the chief house of the Station. This homestead was pleasantly situated near the bank of Reidy Creek, where was a patch of good drift soil that had been converted into a garden, in which, in addition to the usual ornamental flowers and vegetables, were a number of peach and other fruit trees. It was evident that someone connected with the establishment had a thoughtful regard for the orchard; a hollow tree had been cut into lengths of 18 inches or 2 feet, and beside each tree, one of these natural wooden pipes had been let into the ground in an upright position, so that the roots of the trees could be thoroughly watered by filling the hollow stumps with water drawn from the creek; an excellent, and I believe a very effective arrangement. In the garden I noticed a number of salt-bushes, which Mr. Bigge told me had been raised from seed gathered from plants which grew on the Dawson River; they were planted as an experiment, and appeared to be in a healthy condition. For a number of years, specimens of the same plant could be seen in the Brisbane Botanical Gardens. My host had very kindly suggested that I should rest on Sunday, and, anxious as I was to get on, it was difficult to set aside so tempting an offer. But in the morning I had an unpleasant experience; when the horses were brought up from the paddock, the animal which carried my pack was lame. Mr. Bowman joined me in an inspection of the injured hoof, from which I had removed the shoe, and the hurt was too serious to be made light of. Under these circumstances, I thought it advisable to move on quietly as far as Cressbrook, so after lunch I saddled up. But Mr. Bigge was one of those kindly men who would not allow anyone to pursue his journey under such a disadvantage. I must leave him my lame horse, and take in exchange, a very good young "Sailor" mare, which was then in the yard close by! So the exchange was there and then effected, and I left Mount Brisbane with a grateful heart. Many years afterwards, when I again met Mr. Bigge, I reminded him of the incident, which he had altogether forgotten. The exchange was one in which I was in every respect the gainer; but I was doomed to another

disappointment. In the evening I arrived in good time at Cressbrook. Mr. and Mrs. David McConnel and their family were at that time in England ; his brother John and his wife were in possession, and hospitably received me after the good old fashion in the bush. The house was so placed that from the veranda the windings of the Brisbane River could easily be seen. At what was then called "the old cottage," there was a fine bunya, which had been planted in the garden sixteen years before, and it then was bearing cones for the first time. Before going to bed, I obtained leave to get my new mare shod by the station blacksmith, and I handed her over to him as soon as he got to work on the following morning. He made a very neat job of the shoeing, but later on I found to my sorrow it was not a success. I did not get away that morning until 10 o'clock, intending to go only to Colinton, where lived Mr. Balfour, the then owner. I had not gone far, however, when it commenced to rain, and as there seemed every prospect of its continuing, I decided to push on. I had heard much of Cooyar Creek, on which Walter Scott's station, Taromeo, was situated, a rushing stream easily raised by steady rain to flood level ; such was its character. I had lost two days at Ipswich, and had no more to spare ; I must therefore get over it before the flood waters came down. I rode past Colinton in the pouring rain ; up the range where bunya trees grew in their native home ; on over the stony road until Taromeo came in view. I looked hungrily at the snug home, then rode down the creek bank and over the already rising stream. Now, at any rate, the flood would not block me ; but the next stopping place was Nanango, and Nanango was a long way ahead. After crossing Cooyar Creek, the road was less rugged, but the rain still came down steadily, and the light was already failing. Fortunately, the horse I rode was a sensible old fellow, who knew how to stick to the track in the dark ; it passed through thick wattle for what seemed an interminable distance, and there the night was black as pitch, and the rain fell with pitiless force. I could not see a dozen feet in front of me, but "Cock Robin" never made a mistake or a false step, and it was due to his sagacity that I arrived at the hotel at Nanango at half-past nine that night. "You must be very wet," remarked the good woman who attended to my wants. "And uncommonly

hungry, also," I replied suggestively. By the time I had dragged off my sodden garments, and replaced them with others which a waterproof covering had protected, an abundant supper awaited me. A scrub turkey, young and tender, and cooked to a nicety, invited immediate attention, and received it. I had never eaten so nice a bird until then, and I left nothing but the bones. I was far too hungry to feel ashamed of being thought greedy; and the bread and butter were delicious.

I stopped two days at Nanango; not that I wanted to, but because the creeks were again in flood. The little township had one hotel, and six or seven other buildings, but there was plenty of good land in the neighbourhood, which has since proved tempting to the selector. Everywhere I looked, on the morning I resumed my journey—ahead, and on either side of me, the level country was as sloppy as rain could make it, and the little watercourses, which led to the gully which I was following, were half full of dirty water, which hid its own depth. There was a plain track, however; not a dray road indeed, but a well-marked bridle track, and here and there the old scars on trees beside it showed that there was at one time a blazed line to guide those who were not acquainted with the locality. My new mare, unfortunately, had gone lame, and she became more so as we proceeded on our journey. Then those little watercourses were in some instances still and almost pool-like where the track crossed them. I dodged round some of them, as I had no desire to get soaked in deep dirty water, now that all my clothes and kit were dry. But looking for better crossings becomes tedious and wastes time, so I began to take them on chance, and did so in several instances with success; but I chanced it once too often. The gully I was approaching had not a suspicious appearance, and I faced it with confidence. As I had no companion, there was nobody to laugh at my misfortune, and just then I felt no disposition to laugh at anything. My pack mare took a step forward, and down she went. As she sank, the water rose steadily up her sides and over her back; then my pack began to disappear, and at last was completely submerged. Oh! the wretchedness of it; all my dry clothes must be saturated, all that were clean must be discoloured by the muddy water. Happily, the good old

horse I rode missed the hole, and I escaped without a ducking. On a memorable occasion some years later I was less fortunate ; with a couple of hands I was taking some cattle from the coast to a station on the Dawson. We had deluges of rain as we went up the Calliope River, and on the following day had to get over the many crossings of Rainbow Creek, which was running strong, and in places pretty deep. The last crossing of the day was more formidable than any of the others. It was below the junction of Rainbow Creek with the Callide, and the doubled volume of water looked uninviting enough for anything. The bed of the creek was full of tea trees, and only a narrow way had been cleared as a drayroad. Fortunately, the stream here was not very swift, and the tall horse I was riding took me over with only a short swim. As soon as I returned we forced the cattle over ; then we followed. My stockman, Jack McKenna, leading the horse which carried our spare clothes, blankets and provisions ; but when we reached deep water, my pack horse refused to swim, and as he floated down with the stream, Jack had to let go the halter. An overhanging branch soon caught the pack, and presently old Sandy's legs came to the surface a little below the obstruction. When he rolled over right way up again, the pack-saddle and all had disappeared ! That night we stopped with good old John Sutton, at the Callide station ; he had for a time given up his spiritual vocation, and taken to the business of squatter. During the evening, I wore such of his garments as met the necessities of the occasion, and dried at a roasting fire the only clothes I had left. What a blessed thing it was to have them beautifully dry in the morning, but——. Well we got away with the cattle in good time, and I rode ahead to see how the creek was at the bottom of the paddock. It was running very strong, and the backwater had filled a small gully which joined it ; but I had often ridden up and down this road, and the gully at this point was shallow ; the bridle track, too, was plain enough, and had been lately used ; I followed it therefore with confidence, but only to find that the rain had washed away the crossing. The horse I rode carried me ashore without difficulty, but my clothes, from above my waist to the soles of my feet, were completely saturated. My old friend, Morton, of the Prairie station, was just nine

inches less in height than myself, but he found me some slop clothes in the store, which had to do duty while my own garments were once more dried. But this is a digression.

I arrived at Baramba station in due course with a mist rising from my pack, as mist rises on the hillsides after summer rain. My schoolfellow, "Tom" Jones, part owner of the station, was in Brisbane, or elsewhere, but his overseer and wife ministered to my inward necessities. Then I removed the shoe from my mare's lame foot, and from one of the nail-holes dribbled the tell-tale blood! There was no Francis Bigge here to tell me to take that better horse and leave my lame one; and the overseer, good fellow though he was, had no such power; there was nothing for it but to wait. I spread my limited apparel, my saddles, etc., over the fences, and did what I could to pass the time as these dried. Next morning, the mare was still very lame, so again I waited, but in the afternoon, having cleared a channel in her hoof that the discharge might escape by, I tacked on the shoe so that I might save time in the morning. On the second day, I thanked my hospitable entertainers, and jogged on quietly. At about 1 o'clock I passed the station owned by the Jones Brothers; Boonara it was called. I was almost near enough to catch the smell of a well-cooked stew, but the mare could not be hurried, and the road was long. Some time afterwards, Thompson, a relative of the Joneses, overtook me, and we rode on together until in the evening we found quarters and were hospitably received by Mr. Lawless, at Boobyjan.

I was still anxious about my tender-footed mare, and when on the following day I left Boobyjan, I had to take her along very carefully. That evening I reached Gigoongan, where lived George Mant and his wife, a daughter of Dr. Palmer, of Bathurst. Her brother Edward had been at school with me for some time, and I hoped to meet him in this new country. I was disappointed however; not very long afterwards he was drowned in the River Boyne. The Mants had no children at this time, but they had two very fine tabby cats, special favourites, who were quite at home in the drawing-room. The older of the two had been doing battle with a stranger from the bush, and brought home a very much damaged hind leg. The younger one was a splendid animal in magnificent condition. These engaged

our attention during part of the evening, and then we talked of many things. I went early to look at my horses next morning, and was dismayed to find my mare lame in another foot. Mant was with me, and we struck off the shoe, but only to find one of the nails had touched her too close, and inflammation had set in. Never had I such bad luck, but again I had the good fortune to be with an exceptionally good fellow. I must stay a day, and then if the mare was no better, I should have another in place of her ! So I promised to stay, and we walked towards the house ; we were met by the servant girl, who told us with the utmost excitement how " the wild cat " had just rushed out from the bachelors' quarters, and into the sorghum. Mant said we must have him, and, armed with shotguns, we took up a position where the monster might be dropped as he crossed a narrow path between two patches of sorghum. My instructions were not to lose a moment when the dogs brought the stranger to the path. Then we heard a rush through the sorghum, and we both stood with finger on trigger. " Now he comes ; don't miss him " said my friend, and I fired. At one time I could do some fairly smart shooting, but that was the best shot I ever made and Mant's favourite young tabby lay dead on the path before us !

George Mant was one of those very good fellows of whom they say in the bush—" My word, but he is a white man ;" and so he is up to the present time. He has been blessed with a large family of girls and boys, but he has had a lot of bad luck, too, and still pluckily fights on against drought, ticks, and other disadvantages. When I started next morning, a chestnut son of " Cain " carried my pack, in place of the " Sailor " mare, and afterwards, on the station, he proved a very useful horse. Teebar station, which belonged to Mr. Eaton, was about three miles distant from Gigoongan, but by visiting the last named place, I missed Teebar. My business took me to Degilbo, and I followed a track I had used a few months before, and which brought me into the Maryborough-Gayndah road, not far from the Bluff. It was a relief to reach Degilbo, though I suffered some days detention there. Most of the horses I had brought from New England I had sold before I went to Sydney. Those I retained were running up a gorge about three miles from the

station. These I got together so that I might not be further delayed when my business with Mr. Walsh had been completed. Edward Mullett, who was at this time manager at Milton, came to Degilbo while I was there; this was as fortunate for me as it was agreeable, for he helped me to drive about a dozen spare horses when we started on. In due course, I parted with my very kind friends, the Walshes, Staying with them for a time, was good old Mrs. Brown, of Colstoun, on the Paterson River (Mrs. Walsh's mother). and her youngest daughter, the wife of Dr. Walter Brown, of Parramatta; they had come up for a few week's visit.

Starting soon after breakfast, Mullett and I jogged on quietly by a cross-country track to Stanton Harcourt, not particularly good country, and largely overgrown with gum saplings and wattle. It belonged to Mr. Corfield, but Mr. Spain was in charge at the time. We went on as far as Walla, and crossing the Burnett, claimed the hospitality of Mr. and Mrs. John Barker, who, not long before had bought out the former owner. Livingstone had latterly sold his Teninger station, and started North with his sheep in search of another run. The Walla house is beautifully situated on the left bank of the River. Immediately under the bank was a mass of columnar basalt in an upright position; where the columns had broken away there were some well protected natural bathing holes. There is a similar outcrop in the bed of Baramba Creek, not far from Gayndah; persons who travel that road by coach never forget the crossing of Baramba Creek. A similar columnar basaltic outcrop may be seen beside the road between Walla and Teninger. There were some fine orange trees in the garden at Walla, and some of these were still there when I visited the place a few years ago. The one object of which John Barker was specially proud, however, was his stockyard, which then was about finished. "Jim" Hobbs, a monster of strength, who erected it, afterwards came on to me, and put up the Rodd's Bay yards. But John Barker must have the crack stockyard of the Burnett! The round posts were enormous, and all the rest of the timber was proportionally large; the rails were so wide that they met, and formed a wooden wall in the clefts of which no man could even get toe-hold. Cattle were more or less rowdy in those days, and the thought of work



ing them in a yard that could not be got out of in a hurry was not attractive to the hands who had to be so much amongst them. As for John Barker, he laughed at their fears, but one day he was doing the drafting in the lane, which was, if possible, more closely fitted than the rest of it; a lively buck more than twelve months old took him from behind, and when John was helped over that fence, his language was out of the common; the wound took some weeks to heal, and gave him ample time to reconsider the question of closely-fitting rails. I am under the impression that foot holes had been cut in them before I next saw the yard.

From Walla we rode on to Gin Gin, which, at that time, belonged to Messrs. A. and A. Brown; they bought it from William Forster, who afterwards became Premier of a New South Wales Ministry. A. P. Barton had bought from the Browns the country embracing the heads of Gin Gin Creek, and was still busy over his improvements. We struck the Kolan River about eight miles further on, and Munduran station, then owned by W. H. Walsh and his partners. Bernard Witt was in charge of it; formerly it had belonged to James Landsborough, but he had moved on with his family to Raglan. The next station we came to was Kolongo, where resided William Harvey Holt, who afterwards moved North to Glen Prairie. Holt was the great horse authority in that locality, and there was no other who could sell a horse to so great advantage. The freedom with which he named scientifically every bone and muscle of a horse excited the admiration of all his friends. We all liked him, though his "jaw-breakers" were more than most fellows could understand. He was away from home when Mullett and I arrived there, but he had in charge a "supreme" young man, who, from his conversation might have been thought to be the owner of the station, and a few others as well. He was really a "jackaroo."

In these modern times the road northwards from Kolongo surmounts a rough range and crosses the Kolan at Toweran. In 1861, it kept a more easterly course, and struck the river at Wocogo station, which was then occupied by Huxham. Wocogo has disappeared and Toweran, some miles higher up the river, has taken its place. From this station the road ascends a low range, which, as a difficulty in the way of traffic,

would not count. It is really the Dawes Range, which separates the waters of the Kolan River from those of Baffle Creek. The first station North of Toweran, on the main northern road, is Warro, which for many years was occupied by my old friend, F. A. Blackman; about 28 miles westward from it is Molangool. In 1860, Dr. Bingman occupied it, but a little later W. H. Gardin, who had been in partnership with "Long" Ramsay, in Canoona, when the rush to that locality took place, succeeded the doctor. Thornhill, opposite to Warro, was about the same time occupied by Buchanan, who soon afterwards made way for Mr. James Glennie. North of this came three blocks of unoccupied country, belonging to Drs. Walter and Henry Brown; they were named Silex, Ilex, and Goschen. Not very long afterwards, these were bought by Robertson Brothers, of Baffle Creek, and they exchanged them with Cox and Blomfield, of Miriam Vale, which adjoined them on the North, for a piece of country on Baffle Creek, between Miriam Vale and Taunton. Mullett and I did not get to Miriam Vale on this occasion; we travelled eight or ten miles along the road from Warro towards Gladstone; then turned to the left, and following what was known as Living's track, crossed a range, which was decidedly rough, and dropped down on to the Boyne River at Eubobo. At this place, the brothers Living had sheep for a time, and George Living contrived to drive a bullock dray across by the track, which ever afterwards bore his name; or at any rate so long as it could be distinguished as a track. From Eubobo, we followed the Boyne down to Milton, where Mullett lived as manager; two roads to Gladstone were then in use, one by Riverstone, Sir Maurice (then Captain) O'Connell's station, on the Boyne, the other by Barmundoo, where for a time, A. H. Brown (the British Lion) resided, thence by East Stowe, owned by old Robert Bell. This road I took. Had we followed the direct road from Warro, we should have passed Miriam Vale head station, and then through Rodd's Bay, as yet unoccupied and which I had just bought, crossing the Boyne sixteen miles from Gladstone, where that river is tidal. The distance I had travelled between Brisbane and Gladstone was about 350 miles. As soon as possible after arriving at the latter place, I started out about 20 miles to the spot I had chosen on

Rodd's Bay for the head station, and camped that night with Livingstone, who had removed his sheep from Teningering on the Burnett. I gave him leave to shear them on my run, and thus had him as a neighbour for several weeks. He had a poor lot of men with him, and when they lost sheep, as they not unfrequently did, it was always attributed to the blacks, of whom I had seen scarcely any. The men seemed to suffer from what is sometimes called "blue funk," and the climax was reached not long after I had got my own men out. One evening we heard some firing of guns and wondered whatever it all meant; but we took matters calmly, never dreaming of danger. Next morning a tell-tale man let us into the secret. One lot of sheep which were camped some distance from the rest would not settle down for the night as usual, so all hands went over from the main camp taking their rifles and their fears with them, and they probably contributed to the confusion. After a time there was a cry, "the blacks are sneaking on us!" There were the firesticks they carried, moving hither and thither, in a small scrubby gully, so bang, bang, went rifles and revolvers; otherwise there was no noise, nor was an attack made by the niggers, and the sheep were driven with haste to the main camp. After all, it turned out that the alarm was caused by fireflies, of which there were plenty about the banks of the watercourses!

Joseph Wilson, who has just completed a new house at Gin Gin, came on to me, and erected my house, and out-houses. His wife did the cooking, and such other domestic work as was needed—first of all while my homestead consisted of a couple of bark humpies, and later on, when the more pretentious buildings were sufficiently advanced to be occupied. Few people have been blessed with a more excellent couple than Joe Wilson and his wife. Wilson was a good carpenter and builder, and needed no watching; he was a thoroughly reliable man. Mrs. Wilson had a special horror of dirt, and a bark humpy, with an earthen floor, was a model of cleanliness while under her direction. She made yeast for her own use, and her bread was the pride of the district, while nobody who ate the food she cooked was ever known to suffer from indigestion! Between Ipswich and Gladstone I passed only two hotels, that between the Norths and Mount

Brisbane, and that at Nanango ; the bush hospitality which was common in those days supplied such accommodation as travellers needed.

On this journey I made some new friends in their native quarters. On the range between Colinton and Taromeo for the first time I saw bunya-bunyas growing where Nature planted them. The bunya grows, I believe, in a natural state, only on what is known as the Bunya Mountain and its spurs. We have lately been told that it has been found on one of our Northern rivers. I take leave to doubt this. Many years ago—probably five and thirty—I was told by Mr. MacMillan, of Airdmillan, that he had seen trees very similar to bunyas on the Herbert River ; when he inspected them closely, however, he found his first supposition was incorrect. Mr. MacMillan is a careful observer, and I think his statements may be relied on. The trees I saw between Colinton and Taromeo were somewhat disappointing, and could not be compared for girth, height, or beauty of form to those on the Bunya Mountains. On the Kolan River, near Munduran, there were many fine-grown scented gum trees (*Eucalyptus citriodora*) In the evening, when the dew is falling, or in the early morning, the air beneath these is strongly scented. On Granite and Baffle Creeks, which unite close to Miriam Vale, and on Coliseum Creek, which flows into them, there are vast numbers of Moreton Bay chestnuts (*castanospermum australe*), many of them grow to a considerable height. In the scrubs of the Lower Burnett, I ought to mention the bottle tree (*sterculia rupestris*) which grows to a large size ; I had previously seen splendid specimens of this tree on the Dawson River. Near Miriam Vale station there are numbers of ~~Leichhardt trees~~ (*Sarcocephalus cordatus*) ; one very fine one close to the station house. Some of these grow on Rodd's Bay also. On one creek on Miriam Vale *Barklya syringifolia* was flowering profusely, every branch being loaded with masses of golden blossom. I may also mention the fig (*Ficus glomerata*), the pink fruit of which hang on the stem and branches in masses like bunches of grapes, and are inhabited by dozens of curious flies. The above are the more conspicuous of the trees I had been previously unacquainted with. I ought not, however, to omit all notice of the umbrella tree (*Brassaia actinophylla*)

which grows freely on some of the pebbly creeks, and as freely on the crags which occasionally surmount precipitous hills. Numerous smaller plants, some of them of great beauty, grow through all this coast country. On some future occasion I may go more fully into this subject. I need scarcely refer to the quadrupeds, birds, or insects of these districts, since they are common to most of the Queensland coast country south of the tropics.

In the foregoing notes, I have not attempted to give the distances from place to place. I have trusted solely to my memory in what I have described, but could not trust it as to distances; moreover, bush roads are very often changed as the country becomes better known, and distances which might be correctly stated in respect to roads more than forty years ago, would be altogether misleading if applied to the roads at the present time. All this country has changed wonderfully since 1861, for as the poet sings:—

“All things must change  
To something new, to something strange;  
Nothing that is can pause or stay.  
The moon will wax, the moon will wane,  
The mist and cloud will turn to rain,  
The rain to mist and cloud again,  
To-morrow be to-day.”

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# DESCRIPTION OF A TYPICAL QUEENSLAND LAGOON.

(THE ENOGGERA RESERVOIR, NEAR BRISBANE)

WITH METHODS OF RENDERING THE WATER FIT FOR A  
TOWN SUPPLY.

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BEFORE commencing this paper and in order to prevent misunderstanding, I would like to state that I claim to be neither a Biologist—in the sense in which the term is used in connection with water—nor yet a Bacteriologist, consequently, in the descriptions and lists of the biological contents of the water which accompany this paper I have confined myself to the enumeration of the genera only, as the determination of the species is, as all know, a task which may only be successfully accomplished by experts who have made a life study of the subject. Similarly, in the department of Bacteriology, I have confined myself entirely to quantitative estimations.

The lagoon under consideration, which is situated near Brisbane, is an artificial one, and was formed by throwing an embankment across the bed of a creek, the upper waters of which it receives. It has been in existence for nearly forty years. Its watershed has an area of 8,295 acres, for the most part heavily timbered, and covered in some places with fairly dense undergrowth.

The catchment area is not fenced, but the lagoon itself is surrounded by a fence placed at a distance of 1 chain from the water's edge. There are practically no human habitations on the watershed, but cattle roam all over it at will.

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The banks of the lagoon are cleared of timber for a distance of about 8 chains from the water's edge. There are several tributary creeks feeding the lagoon, but only two of any size.

The area of the lagoon when full, is 186 acres, of which about one-third consists of shallows less than 13 feet deep at high water, that is, when the lagoon is full.

The greatest depth of water is 55 feet, and the estimated total capacity is 1,000,000,000 gallons.

The lagoon contains abundant growths of common water weeds which Mr. Bailey, the Colonial Botanist, has been good enough to identify, and a list of which will be found in the Appendix I to this paper. Many of these weeds die, and rise to the surface whenever any considerable and sudden rise of water takes place in the lagoon. Some of these plants are undoubtedly responsible for a proportion of the colour and odour of the water. Mr. G. C. Whipple, in his work on the "Microscopy of Drinking Water," states that *Myriophyllum*, of which there is abundant growth in this lagoon, "possesses a natural odour that is strongly vegetable, and at times almost fishy," this odour is imparted to the water whenever the plants die or are crushed and broken. I have myself observed this, and I have also found this plant to cause a sensible increase in the colour of water in which it was placed.

There is practically no flow of water in the creeks feeding the lagoon except after heavy rain. There are many pools more or less deep in the bed of the main creek in which abundant growths of *Spirogyra*, etc., exist after dry weather has continued for a short length of time. These growths are washed into the lagoon whenever any flow of water takes place in the creek.

The average total rainfall at the lake per annum, for the past five years, was 33.93 inches. (For 1904-5 rainfall see Appendix II.)

The water discharged into the lagoon by the creeks is, for the first day or so after heavy rain, highly charged with organic matter evidently of vegetable origin, and is also highly coloured, but after flowing for some little time it gradually improves in quality until, having run for, in some cases four days, the creek water is in some respects purer than the bulk of the water contained in the lagoon. (Appendix III.)

In a lake of this type one of the most important factors in connection with its biological and chemical composition which we have occasion to enquire into is the period or periods during which the water in the lake is in a state of stagnation or circulation, these periods depend almost entirely on the temperature of the water throughout its depth at different times of the year. In colder climates there may be two periods of circulation of the water in a lake, but in a climate like ours there can be only one unless indeed, the lake be over 200 feet deep when stagnation would probably be permanent.

During the months between July and May, there is a difference of from 5 to 20 degrees Fahrenheit between the temperatures of the surface and bottom water in this lagoon, it is to be expected therefore that during that period the bottom layers of water are certain to remain at the bottom by virtue of their greater density. This period is termed the "period of stagnation." It causes several changes to take place in the character of the water at the bottom of the lagoon. The most conspicuous change is that of colour. Whilst the colouring matter in the water remaining at the surface is bleached by the action of the sun's rays, that at the bottom grows gradually darker until, near the close of the stagnation period it has a decided opalescent turbidity and a rich brown colour, which deepens after being drawn to the surface. This colour is probably due to the presence of iron in the water, as well as to the sedimentation of the organic matter, which is much increased in the bottom layers during this period. The oxygen dissolved in the bottom water disappears during stagnation, owing to its absorption by the organic matter, putrefaction takes place, and the water acquires an offensive odour, in which the familiar sulphuretted hydrogen plays a large part. The effect of stagnation on the microscopic organisms is no less remarkable, owing to the absence of oxygen and light little life exists at greater depths than 20 feet, but the water at the bottom acquires an abundant supply of food material, both organic and inorganic, suitable for microscopic life.

Towards the end of May, however, on the approach of colder weather, the decrease in temperature at the surface increases the density of the water there, gradually leading to a complete vertical circulation of the water in the lagoon,



until, about the middle of June, the temperature of the water is practically the same throughout all depths. About that time stagnation once more commences, and continues throughout the remainder of the year, until May comes round once more, when the process is repeated. (Appendices IV and XIII.)

During the period of circulation the character of the water at the various depths is completely changed, the colour of the water becomes uniform throughout all depths, consequently the colour at the surface increases; indeed I have found it on one occasion, *viz.*, 5th June, 1905, to be slightly darker at the surface than at the bottom; dissolved oxygen is now found at all depths, and the microscopic organisms are evenly distributed, whilst the food material before mentioned is carried to the upper regions where, with light and oxygen, the organisms are able to utilise it.

The following figures illustrate in a striking manner the difference between the condition of the water during stagnation, and during the period of circulation :

	DURING THE STAGNATION PERIOD.			DURING THE CIRCULATION PERIOD.		
	MAY 19TH, 1905.		MAY 5TH, 1905	JUNE 5TH, 1905.		JUNE 20, 1905
	Colour Units.		Dissolved Oxygen.	Colour Units.		Dissolved Oxygen.
	Red.	Yellow.	per cent. of Saturation.	Red.	Yellow.	per cent. of Saturation.
Surface	1.9	6.5	58.5	3.0	10.0	103.0
Thirty Feet			nil.			60.8
Bottom (45ft)	42.0	32.0		2.7	8.0	

(Colour determined by Lovibond Tintometer.)

It will be seen therefore that in this lagoon, containing as it does an excessive amount of organic matter, the occurrence of these phenomena produces no improvement in the quality of the water, and is in fact a large factor in the process of deterioration. Before leaving this subject, however, on which one might talk all night and concerning which much has been written, I might remark that stagnation is productive of no disagreeable effects when the lake bottom contains no organic matter, and that it does not occur in shallower lakes such as those only 10 to 15 feet deep, for in such lakes thermal stratification hardly exists.

Quantitative estimations of the bacteria in this water have been made at irregular intervals since November, 1904. As usual with waters of this class the numbers are comparatively small, averaging about 400 per cubic centimeter when grown on neutral agar medium. (Appendix V.)

Sufficient analyses have not been made to show the seasonal variations in the different micro-organisms in this lagoon water, it is noted, however, that the diatom *Synedra*, and the chlorophyll alga *Protococcus* are always more plentiful after rain.

Comparatively large areas of a scum consisting for the most part of *Anabæna*, *Protococcus* and *Oscillaria* float on the surface of the lagoon during the summer months, and are found generally near the edges where they have been blown by the prevailing wind. The protozoa *Peridinium* is also very plentiful, and is found in large numbers associated with the scum before mentioned.

A micro-organism which I consider to be a variety of *Protococcus* is the predominating organism in this lagoon; it may be seen at all times of the year, but particularly in summer and after heavy rains, distributed throughout the surface as a bright green powder of irregularly shaped particles. This organism, which I have not yet been able to identify satisfactorily, but specimens of which Mr. Bailey has kindly forwarded to Professor Borge, in Germany, for determination, is most obnoxious when plentiful; it has not yet given trouble in the lagoon under discussion, but in a similar and not far distant lagoon it became, some months ago, so bad that the water was of a bright green colour throughout, and at the edges in some places the organism was so plentiful as to impart to the water the consistency of mud. The odour given off by this organism was so bad that a workman, the nature of whose employment required that he reside near the lake, asked for and was actually supplied with a considerable quantity of disinfectant for use around his residence whilst the lake was being emptied.

*Spirogyra* grows abundantly during the summer in the shallow water round the edges of the lake.

When this lagoon water is passed through iron pipes under low pressure, abundant growths of the Bryozoa, *Plumatella* soon become attached to the interior surface

of the pipes. It is found in active growth and decay nearly all the year round, but about the autumn decay is usually more marked, whilst it is less noticeable in the winter. The growth extends at times for about 5 inches from the iron to which it is attached, forming a dense mat in the lower 2 inches. Statoblasts are found in the *Plumatella* all the year round, but are most plentiful when the decay is most marked. Freshwater sponge and *Hydra* are always found associated with the *Plumatella*. The smell from this Bryozoa and Sponge when in process of decay is most offensive, and is a serious cause of odour in the water when it is passed through iron pipes. I might here remark that these organisms will not grow in the water which is produced in the methods about to be described. (Appendices VI. and XII.)

I find it difficult, in fact almost impossible to describe satisfactorily the odour of this water; it may be described in a vague manner as a mixture of Vegetable—Salt Marshy—Grassy and Fishy—each item predominating at different times of the year. During long periods of drought the odour is almost absent, and it is I think most offensive when it has been in contact with decaying *Plumatella*.

As regards chemical composition I find the water of this lagoon to be comparatively constant throughout the year, a list which I have prepared giving the monthly averages of weekly analyses of samples drawn 5 feet below the surface since May, 1904, shows the organic matter as indicated by Albuminoid Ammonia determination, to have been highest in March, when it was averaged .367 parts per million for the month, the lowest figure obtained being for January, when it averaged .260 p.p.m. Nitrates were absent throughout the year, whilst Nitrites were only occasionally searched for, but never found present. (Appendix VII.)

In colour the samples varied considerably, the highest figures being obtained in May and June during the period of vertical circulation in the lagoon, the variation being from 52 on the platinum scale in June, 1904, to 20 on the same scale in January, 1905. The Chlorine figure was practically constant throughout the year, being about 34 parts per million or roughly 2.4 grains per gallon. The hardness of this water is very low, being about 3 degrees on Clarke's scale.

In spite of the comparatively large amount of organic matter which it contains this water is not by any means an "acid" water, except by virtue of its "Free Carbonic Acid," that is to say it contains no acidity due to "organic" acids.

In no case would any of the samples obtained from the lagoon have been considered suitable for a town supply if only on account of the amount of organic matter indicated by the figures quoted.

Having thus briefly reviewed the Physical, Biological and Chemical conditions obtaining in this lagoon, I now come to the second portion of my paper, *viz.*, the description of methods of rendering this water fit for a town supply.

Before commencing on this subject I would like to make one more disclaimer. I have had no opportunity of testing the processes about to be described on anything like a large scale, the results having been obtained on small filters, the largest being 76 square feet in area, and yielding nearly 5,000 gallons of filtrate per 24 hours. Nevertheless, the greatest care has been taken in every case to imitate as closely as possible the conditions which would exist were the filter an acre or more in area, and I am confident that the results obtained on this experimental scale closely approximate to those which would be obtained on the larger scale required for a town supply.

It may be well at this stage to consider briefly the various methods in use for securing a pure supply of water from a source of this nature.

First there is the method sometimes adopted of cleaning the watershed and also the lagoon which contains the water collected from it. This is a most desirable proceeding, though there exists some doubt as to the permanency of the benefits to be derived from cleansing the bottoms of such lakes, but time does not permit of going into the question in detail here.

With smaller lakes it is sometimes the practice in warm climates to roof them over entirely, thus preventing the growth of the various forms of microscopic life which are responsible for a large portion of the obnoxious odours and tastes in the water. Water stored in this fashion, collected of course from a clean watershed, but which before roofing

the lake has been a constant trouble on account of vegetable growths is said to remain "clear and pure as crystal, and nearly as pure as distilled water;" this statement is made after 30 years experience by Mr. C. Eliot, City Superintendent of the Spring Valley Waterworks, of San Francisco, in a letter to the Committee of the American Waterworks Association, on Animal and Vegetable Growths affecting water supplies, 1890. When a reservoir was too large to permit of the construction of a roof over it, the same object is said to have been accomplished by the construction of a large raft which floated on the surface of the water, and from under the centre of which the supply was drawn.

Of other methods of purifying lake waters *in situ* the most important is that devised by Dr. G. T. Moore, and which is reported to have been successfully used in several lakes in America. The method consists essentially in the addition of sulphate of copper to the water in the lake with the object of destroying the micro-organisms contained therein. The method will be dealt with later on in this paper.

In nearly all other methods the purification of the water is effected outside the lagoon.

These methods comprise—Settlement in covered basins, either by simple subsidence or subsidence aided by coagulants such as lime or alum, and with or without the use of screens. Sterilization by distillation, which is as a rule too costly to be used in connection with a city supply, and lastly Filtration.

Filtration is the most important of these methods and the most generally used. It may be divided into two great sections—Plain Sand Filtration and Mechanical Filtration.

The first section includes all sand filters, both continuous and intermittent in action, which depend for their efficacy on the power of the sand alone to retain and remove suspended matter in the water, and on oxidation effected by the life processes of bacteria. These filters are generally operated at slow rates, such as from  $1\frac{1}{2}$  to 5 million gallons per acre per day.

In the second section, I include all those methods of filtration in which sand filters are used in conjunction with coagulants and all filter presses of canvas or other porous

material such as the fused mixture of glass and sand; used in the Fischer Plaque filter. Filters under this section are nearly always operated at extremely rapid rates amounting in some cases to 130,000,000 gallons per acre per 24 hours.

There are methods of filtration which do not come under either of these heads, but all the more important processes at present in use on a large scale are included.

As I have already indicated, the water of this lagoon is objectionable for a town supply owing to its appearance, colour, smell and taste, but apart from these aesthetic considerations, water of this description is to some people positively harmful, causing when imbibed in any quantity various stomachic complaints.

The purification of waters of this class is generally considered to be one of the difficult problems which Water-works Engineers and Chemists have to deal with.

In the experimental purification of this water, the following methods have been tested:—

(a) Plain continuous filtration in filters constructed entirely of sand, with, of course, underdrains, and in filters whose sections consist of layers of sand, ashes and crushed quartz of various grades.

(b) Plain intermittent sand filtration.

(c) Mechanical filtration, with lime and alum as coagulants.

(d) The Anderson Process, which comes under my heading of Mechanical Filtration.

A method of water purification has been tried which, strictly speaking comes under neither of the heads mentioned, but which may for practical purposes be described as slow, downward, intermittent filtration. This ingenious process was suggested by Mr. Arthur Morry, of this City, who was at that time District Supervisor of Public Works, and in that capacity devoted a considerable amount of time and thought to the subject of water purification. A combination of this process and ordinary sand filtration was also experimented with. One more process has been tested, namely, Dr. Moore's method of removing Algae and Bacteria from water supplies by means of copper sulphate.

#### CONTINUOUS SAND FILTRATION.

Although no less than five different filters have been used in this investigation, it is sufficient for the end in view to

consider in anything like detail the results obtained from but one of them, a filter whose section is composed entirely of sand. This filter has an area of 25 square feet, and a section as follows :—

Fine sand at top of bed (effective size .335 <i>m.ms.</i> )	41 inches
Underdrains composed of various grades of gravel	12 ..
<hr/>	
Total depth of material .. .. .	53 ..

The depth of water over the sand was 41 inches, whilst the maximum loss of head was 91 inches. The method of operating the filter is as follows :—It is fed from below with filtered water until it attains a depth of about 6 inches above the surface of the sand, unfiltered water is then fed on to the bed from above, and filtration commenced as soon as the water in the filter is 2 feet over the sand. For the greater portion of the time during which this filter was in operation, water was discharged on to the bed through an aerator, which divided it into a comparatively fine spray. The filter was allowed to run until it became so choked with organic matter that a “head” or pressure of 7 feet 10 inches was necessary to force the water through the sand at the required rate. The feed water was then turned off, the sand allowed to drain, and the surface removed for a depth of about half-an-inch. The filter was then restarted as before detailed. The period between the times when scraping the surface to remove clogging becomes necessary is termed a “run,” and varies according to the nature of the applied water. The average length of run for this filter during the time it was in operation, was over 70 days, showing clearly that the sand used for the filter bed was not by any means too fine, as this is a comparatively long run for a filter of this type. This filter remained in operation for 183 days, the average rate of filtration maintained throughout that period was exactly 2 million gallons per acre per 24 hours. Chemical and Physical analyses of the unfiltered water and effluent were made weekly, and a monthly average of the percentage reduction of organic matter and colour, is given in Appendix VIII.

The average reduction of organic matter, as shown by the Albuminoid Ammonia determinations throughout the whole period of operation was more than one-half, whilst the reduc-

tion in colour was 66 per cent. of the yellow, and 93½ per cent. of the red units determined by means of the Lovibond Tintometer. The number of bacteria per cubic centimeter in the effluent and unfiltered water were also determined from time to time, the average result of nine determinations showing 462 per c.c. in the unfiltered water, whilst only 7 per c.c. appeared in the effluent, which is equivalent to a per centage reduction of 98½. Throughout the whole time the appearance of the effluent was good, its taste was excellent, no odour was noticeable, and it was to the ordinary observer practically colourless. The sand used in this filter was of poor quality, being the result of recent decomposition of granite, it was very friable and exceedingly difficult to clean, and even when washed with apparent thoroughness still contained a good deal of organic matter. Had better sand, such as that obtained from the Brisbane River bed been used, the results from this filter would doubtless have been still better.

I have described this filter in preference to the other sand filters mentioned, because it is the most typical of the group. Even better results were obtained from one of these filters in whose section ashes played an important part, but this improvement was proved to be due not to the ashes, but to the finer grade of sand in the surface layer.

The last mentioned filter contained besides cinders and crushed quartz, 12 inches of sand on the surface of the bed, which had an effective size of .28 m.m.s. The sand used was of superior quality to that in the first-mentioned filter composed entirely of sand, which probably accounts for the better chemical results obtained. The Bacteriological results were however not quite so good, probably on account of the fact that the depth of the sand layer in this filter was less than in the former filter. The length of run or period between scrapings was also not so good as for the sand filter, averaging only 31 days. this was to be expected on account of the finer grade of sand employed.

During the warmer weather and on account of the increased bacterial activity occasioned thereby, it was found that the removal of the organic matter and colour by these filters was much greater than during the colder months of the year. For a similar reason the amount of dissolved oxygen



found in the effluents of these filters at the same period was very small, the oxygen in the applied water being practically exhausted before the water reached the outlet of the filter. As the amount of dissolved oxygen in the lagoon water at this time of the year is comparatively low, aerators were fixed at the inlets of both filters. These had the effect of practically saturating the applied water with oxygen, increasing the amount from 75 per cent. of the possible quantity to about 98 per cent. Notwithstanding the increased amount in the applied water, however, the oxygen still continued to be almost entirely exhausted in its passage through the filters, though a slight increase took place in the amount contained in the effluents.

In order to investigate this phenomenon, arrangements were made whereby samples of water might be drawn from different positions in the sand bed. Several determinations of the number of bacteria and the amount of dissolved oxygen in the water at different depths in the sand were made. It was expected that the rates of decrease of bacteria and dissolved oxygen would be somewhat similar, or that the decrease in oxygen would cease in those portions of the filter which contained practically no bacteria; this was expected on the assumption that the decrease in the amount of oxygen dissolved was entirely due to its consumption by the bacteria in the process of oxidation of the organic matter in the water.

It was found that the bacteria were practically all removed in the upper 6 inches of the sand, but that whilst about one-half of the total absorption of oxygen by the filter took place in the first 6 inches, the amount continued to decrease at a fairly regular rate throughout the remaining depths of sand where the water at the same time contained practically no bacteria. I am not able to satisfactorily explain this phenomenon, but intend if possible to investigate further.

#### INTERMITTENT SAND FILTRATION.

Following a line of thought suggested by the last mentioned experiments, an intermittent filter was constructed with a view to testing the effect of more efficiently aerating the sand bed. The filter is 76 square feet in area, and is constructed on the lines of the City filter at Lawrence, Massachusetts, in the United States of America. The bed

of this filter is composed of 5 feet of sand of an effective size of .27 m.m.s., placed over underdrains of gravel and brick. The method of working is as follows :—Water is fed on to the filter bed by means of a gutter placed along the centre of the filter 2 inches above the surface of the sand, no attempt is made to obtain any depth of water over the surface of the sand bed, so that the water flows almost directly through it in such a manner as to leave the greater portion of the surface dry. By this means the growth of algae on the surface of the sand which takes place in ordinary continuous sand filters is avoided, and the periods between the times when scraping becomes necessary are in consequence greatly increased. No water is fed on to the filter for a certain portion of every 24 hours, during which time the filter is allowed to drain, and in this manner the sand bed is completely aerated every 24 hours. Two different periods of rest have been tried for considerable lengths of time in this filter, namely 8 hours and 4 hours, the former period, 8 hours, appears so far to give the best results. The cessation of work for such a large portion of the time naturally necessitates a greater rate of flow through the filter than is the case with ordinary sand filters, in order to accomplish the same amount of work for the 24 hours. Nevertheless, in spite of the increased rate, the reduction of colour and organic matter has been excellent, and the average reduction effected by this filter when working with a daily rest of 8 hours is distinctly better than that effected by any of the ordinary sand filters. The Bacteriological results from this filter are, however, not so good as those obtained from the ordinary sand filters, the average reduction effected being about 74 per cent. (Appendix IX.)

We now come to the consideration of results obtained from filters of the type designed by Mr. Morry, which he describes as "Biological Oxidising Beds." Mr. Morry states that the idea of their construction was suggested by the "Ducat" and "Stoddart" beds used in sewage purification, and which are built up above the ground. In brief the beds are composed of about 6 feet in depth of gravel, or coal, in varying grades; in some of the filters these beds are so constructed as to admit of side aeration, but the feature which is common to all is the method of delivering the unfiltered water on to the bed of the filter. This is done through

an intermitter from which the water is discharged at intervals into the basin of a revolving sprinkler running on ball bearings, which distributes it regularly and evenly over the surface of the filter bed, through which it slowly percolates and flows into underdrains which lead into a small receiving vessel. The object of this method of discharging the effluent is to insure the thorough aeration of the water in its passage through the filters. That this has been effected is proved by the fact that even in the warmest weather the effluents from all but one of these filters contained over 95 per cent. of dissolved oxygen, and it has been proved that this aeration is chiefly produced during the passage of the water through the bed of the filter itself. Altogether 8 filters of this type were experimented with; they may be divided into two classes, namely, those in which sand forms a portion of the filter bed and those in which the filter bed consists entirely of gravel.

Two beds composed partly of sand were tried. In each of these the surface layer was composed of one foot in depth of sand, which was also of the same grade in each case. In one, the remainder of the filter bed was composed of coal in four layers of different grades, the coarsest with material  $\frac{1}{2}$  inch in diameter, being at the bottom, making the total depth of material 6 feet. In the other filter the remainder of the bed is composed of gravel in four layers, which are identical in grade and depth with those in the coal filter. The coal filter is fitted with means of securing both side and bottom aeration, whilst no provision for such aeration is made in the gravel bed. In consequence of this the amount of dissolved oxygen in the effluent from the coal bed is much greater than in the gravel bed effluent. The reduction of colour and organic matter however, was found to be much better in the gravel than in the coal bed filter, whilst the bacterial purification was the same in each, the reduction effected being about 92 per cent. The effluent from this gravel and sand bed filter was in every way excellent, and the average results are equal to the best results obtained by sand filtration.

The beds in which gravel alone was used, though effecting a remarkable reduction in the organic matter and colour of the water, are open to two objections, firstly—They take a considerable time to properly mature or get in working

order, and secondly—Even when matured, their effluents though bright and sparkling and in every other way desirable, always contain a slight amount of matter in suspension, also as might be expected the reduction in the numbers of bacteria is comparatively poor.

The consideration of the foregoing circumstances led to the conclusion that a combination consisting of a bed of this type worked in conjunction with an ordinary sand filter would give excellent results ; the rapid passage of the water through the gravel bed would it was thought effect a partial purification of the water without removing all the suspended matter, at the same time aerating it, and thus rendering it in every way more amenable to treatment by the sand filter. It was decided to try the experiment. A small square gravel filter of the Morry type was constructed with an effective area of 12 square feet and a depth of 3 feet, a small sand filter was also constructed, having an area of 18 square feet, and composed of 2 feet of fine sand. These two filters were arranged so that the sand filter might be conveniently fed with the effluent from the Morry filter. The sand filter was worked in the usual way, but with a depth of only 11 inches of water over the sand. Although only a poor quality of sand was used in this filter, the results of the analyses of its effluent have fully realised the expectations before mentioned. When the combination was worked at a rate which gave a yield of water from the combined areas equal to that obtained from a similar area of the ordinary sand filters, the results obtained showed a reduction of organic matter, which was a distinct improvement on the results obtained from the best of the sand filters, and whilst the reduction of the numbers of bacteria was equally good, the amount of dissolved oxygen in the effluent averaged 66 per cent. of the possible quantity during a period in which the oxygen in the ordinary sand filter effluents averaged only 10 per cent.

Having considered the results obtained by filtration of the water without the assistance of coagulants, the next method for consideration is that of Mechanical Filtration.

The main object of mechanical filtration is to purify large volumes of water with a small amount of filtering material. In order to effectively do this the addition of a

coagulant is generally necessary in order to remove a portion of the polluting matter before filtration, and to quickly form on the surface of the sand in the filter a coagulum which takes the place of the natural film produced by subsidence of suspended matter and bacterial action on the surface of a plain sand filter. This form of filtration is only "mechanical" in connection with the arrangements for agitating the sand during the frequent cleansing necessary, and for the regular dosing of the applied water with the solutions of coagulant.

Experiments conducted with the water of our lagoon showed the best proportion of coagulants to be 1 grain per gallon of alum and  $4\frac{1}{2}$  grains per gallon of lime. Four hours settlement after adding the coagulants but prior to filtration was also found to be necessary.

Time does not permit of a detailed description of the experiments conducted with this process, which extended over a period of six months, I must content myself with stating that very excellent results were obtained throughout the experiments.

For purposes of comparison, I have constructed tables showing the average composition of the effluent of the mechanical filter for a period of three months, during which the best results were obtained at a rate of filtration equal to 104 million gallons per acre per day. For purposes of comparison, I have also calculated the average composition of the effluent from the intermittent plain sand filter before described during a similar period of three months, whilst operating at an average rate per day of 2.23 million gallons per acre, and a rest interval of 8 hours in every 24. I have also calculated in each case the reduction of organic matter effected in the same period. This shows the percentage reduction of organic matter, as indicated by the albuminoid ammonia figures to be roughly 58 in the case of the intermittent plain sand filter, against 56 in the case of the mechanical filter, although the average albuminoid ammonia contents of the plain sand filter effluent was .136 parts per million, as against .123 parts per million in the mechanical filter. It is true also that the best result obtained by mechanical filtration was better than the best result obtained from the plain intermittent sand filter, but in view of the decided

predjudice which exists against the use of alum in connection with the purification of a water supply, whether this predjudice is justified or not, I venture to assert that the comparison is all in favour of plain sand filtration, especially when it is considered that the average results compared are not the best results obtained from plain sand filtration, though unfortunately I have no better figures available from observations conducted throughout a similar period. (Appendix X.)

The next method for consideration is Anderson's Process. This process comes under my heading of Mechanical Filtration, though it has not the objectionable feature of the method just described, namely the use of alum as a coagulant. The process in brief is as follows:—Metallic iron, in the form of cast iron borings or steel punchings is placed in an iron cylinder, through which the water passes on its way to the sand filters. This cylinder is so arranged that by its slow rotation the iron is continually lifted and showered down through the water, which is being passed at a moderate speed through the cylinder. Air also is introduced. By means of this contrivance a small quantity of iron is dissolved in the water through the agency of the carbonic acid contained therein. This iron is dissolved in the form of ferrous carbonate, which on coming into contact with the air is oxidised and precipitated as ferric hydrate in particles more or less coarse, according to the nature of the water. This precipitate settles rapidly, carrying down with it and possibly oxidising the organic matter in the water, and at the same time removing the bacteria also. Subsequently the presence of this flocculent precipitate in the water permits of its rapid and efficient filtration through a simple sand filter.

The use of this process for the purification of our lagoon was suggested to me by Mr. Parkinson, a well-known civil engineer of this city, who was kind enough to lend me a copy of the proceedings of the Institution of Civil Engineers containing a paper by Messrs. Chadwick and Blount, on the results of their experience with this method as a means of purifying the waters of lakes similar to ours in Mauritius and South Africa. The results described in that paper were so very good that it was determined to try the method on our lagoon water.

I regret to say that I am unable to describe the results of experiments with this method on anything but a laboratory scale, but the results thus simply obtained are so very excellent as to warrant the assumption that if tried on a larger scale, an effluent would be obtained which would easily excel the best results obtained by any of the methods I have just described, at the same time requiring a very much smaller area of sand bed, on account of the much greater rapidity with which the water may be efficiently filtered after treatment in this manner. (Appendix XI.)

One more system of water purification remains to be mentioned before I conclude, namely Dr. Moore's method of destroying and preventing the growth of algae and bacteria in water supplies.

The numerous experiments with this method and our lagoon water, which continued without cessation during a period of three months, thoroughly confirm the results obtained in America in similar lakes by Dr. Moore, or under his direction.

The method used for the distribution of copper sulphate throughout the lake is to tow it in coarse bags behind boats, in this manner it is stated that 100 lbs. of the salt can be distributed in 1 hour.

The toxicity of copper sulphate is so great that on one occasion when experimenting with so small a proportion of the salt as 1 to 8 million of lagoon water, only a few protozoa remained in the water after treatment, whilst untreated water which had been standing under exactly similar conditions, contained at the end of the experiment as many as 1,320 organisms per cubic centimeter.

The satisfactory fact was also noted that the organisms which are most objectionable and most plentiful in this lagoon, showed the greatest sensitivity to the sulphate of copper. From the results of the experiments, I think it is safe to conclude that a strength of solution of 1 part of copper sulphate to from 8 to 10 million parts of water is sufficiently strong to effectively remove the obnoxious algae from this water, this proportion stated in other terms is equivalent to 1lb. of copper sulphate in every 800,000 to 1,000,000 gallons of water. I consider also, that if this salt is added

to the lagoon water during the stagnation period before mentioned, a still smaller amount of the salt would be necessary on account of the fact that organisms exist to any great extent during that period only in the upper 15 feet of water, whilst it is probable that the stratification of the water by reason of its varying density would help to maintain the solution in the upper layers of a sufficient strength and for a sufficiently long period to enable it to do its work among the algae; and it is to be remembered also that in the surface layers of water where the algae are most abundant, the solution will in any case owing to the method of application, be for a short period much stronger than one to eight million.

My experiments also proved that when solutions of the strength named were used, no copper could be detected in the water three days after its addition, although the test used would easily have detected the presence of 1 part of copper sulphate in 25 million parts of water. As this proportion is equivalent to 1 part of metallic copper in 100 million parts of water, it may be considered I think that all the copper is eliminated by precipitation.

In the majority of these experiments with copper sulphate,  $4\frac{1}{2}$  gallons of water were used, the containing vessel being glass in nearly every case. Small fish were invariably present, and in no case suffered any apparent inconvenience.

It is impossible here to go into the results obtained in these experiments in anything like detail, and it is sufficient to state that the results indicate that the method could be successfully applied to a water of the type under consideration, nevertheless although the copper sulphate treatment is a most valuable remedy for the unpleasant odours and tastes, and might be advantageously applied where no other method of purification exists, or in conjunction with other methods, it does not remove the colour and dissolved organic matter, and only removes one of the causes of colour and organic contamination, consequently it cannot be said to remove the necessity for filtration.

In conclusion I may state that nearly every one of the methods I have described for the purification of this lagoon water yields a product which would be received with delight



if delivered to consumers by the pipes of any water system in Australia. Not only is the purified lagoon water excellent for drinking purposes, but it is also eminently suitable for other uses ; its softness and freedom from colour rendering it especially desirable for laundry work and steam raising.

It is evident from the results of these investigations that the purification of waters of this type is not by any means the impossibility which tradition has taught us to imagine it.

In the course of these investigations, I have frequently found it necessary to obtain the advice of several of my friends, better versed than myself in various phases of this subject, and I seize this opportunity of expressing my gratitude to these and all others who have rendered me assistance.

#### APPENDIX I.

#### LIST OF AQUATIC PLANTS IN LAGOON.

NAMES SUPPLIED BY F. M. BAILEY, F.L.S., COLONIAL BOTANIST.

*Utricularia flexuosa.*  
*Hydrilla verticillata.*  
*Myriophyllum verrucosum.*  
*Myriophyllum variaefolium.*  
*Jussiaea repens.*  
*Ottelia ovalifolia.*  
*Marsilea Brownii.*  
*Eclipta alba.*  
*Cyperus exaltata.*  
*Polygonum lapathifolium.*  
*Polygonum attenuatum.*  
*Limnanthemum indicum.*  
*Nymphaea gigantea.*  
*Nymphaea flava.*  
*Azolla rubra*

APPENDIX II.  
RAINFALL AT LAGOON, 1904-1905.

Month Ending	Inches
June 1904	0.16
July	1.89
August	0.61
September	1.41
October	1.32
November	2.24
December	2.34
January 1905	9.83
February	3.18
March	2.09
April	5.74
May	1.25
Yearly total	<u>32.06</u>

APPENDIX III  
CHEMICAL AND PHYSICAL ANALYSES OF MAIN CREEK  
AND LAGOON WATERS.

Parts per Million	No. OF ANALYSIS:			
	No 1	No 2	No 3	No 4
Total Solids	150.	185.	114.3	107.1
Total Solids in Suspension	7.2	50.	7.2	7.1
Chlorine	35.7	34.3	33.6	37.1
Free Ammonia	.04	.025	trace	.015
Albuminoid (Total)	.305	.340	.195	.245
do. do. (in solution)	.235	.295	.185	.205
Oxygen Consumed in 15 Mins. at 90° Fahrenheit	3.40	5.24	3.01	1.38
do. do. in 4 hours	8.07	9.46	6.98	2.72
Nitrogen existing as Nitrates	Nil	Nil	Nil	Nil
Turbidity (Silica Scale)	15.0	30.0	10.0	5.00
Odour Warm, Odour is of "decaying vegetable matter"	very strong	strong	decided	very strong
Colour (with Hazen's tubes)	114.	142.0	110.	26.
Colour, Lovibond Tintometer				
Red (Units)	4.4	6.2	3.0	1.0
Yellow "	11.2	16.8	9.2	3.7

**ANALYSIS, No. 1, 15/1/05.**

Water from Main Creek entering lagoon after creek had been running one day in slight flood, rainfall for previous 24 hours 5.37 inches.

**ANALYSIS No. 2, 17/1/05.**

Water from Main Creek entering lagoon after creek had been running two further days slightly stronger than on 15/1/05. Rainfall for previous 48 hours 0.49 inches.

**ANALYSIS, No. 3, 18/1/05.**

Water from Main Creek entering lagoon after creek had been running one further day less strongly than on 17/1/05. Rainfall for previous 24 hours 2.3 inches.

**ANALYSIS, No. 4, 18/1/05.**

Water from lagoon at outlet.

## APPENDIX IV.

## TEMPERATURE OF WATER IN THE LAGOON.

## DEGREES FAHRENHEIT.

Average Daily				1903-1904.		1904-1905.	
Temperature per Month.				Surface.	Bottom.	Surface.	Bottom.
June	..	..	..	58.2	56.5	58.7	58.1
July	..	..	..	57.8	56.8	56.4	54.2
August	..	..	..	59.9	57.1	59.3	55.2
September	..	..	..	65.0	59.9	64.4	56.2
October	..	..	..	69.9	58.0	71.0	57.3
November	..	..	..	73.1	58.9	77.0	58.6
December	..	..	..	79.0	59.9	78.0	59.0
January	..	..	..	78.7	60.6	78.7	59.6
February	..	..	..	77.2	61.0	78.8	59.2
March	..	..	..	75.9	61.4	77.2	60.5
April	..	..	..	69.8	62.0	72.6	61.0
May	..	..	..	65.6	61.8	65.9	58.2
Maximum temperature							
for above period				83.0	63.5	86	62
Date				21/1/04	May '04	3/1/05	April, '04.
Minimum temperature							
for above period				53.0	55.0	54.0	54.0
Date				16/7/03	June, '03	4/7/05	July, '04.

## APPENDIX V.

TABLE SHOWING THE BACTERIAL CONTENTS OF THE SURFACE  
LAGOON WATER ON DIFFERENT DATES DURING

1904-1905.

Date of Analysis.					Bacteria per C.C.
28th November, 1904	..	..	..	..	130
5th December, 1904	..	..	..	..	150
12th December, 1904	..	..	..	..	170
19th December, 1904	..	..	..	..	130
2nd February, 1905	..	..	..	..	1100
8th February, 1905	..	..	..	..	375
16th February, 1905	..	..	..	..	350
21st February, 1905	}	contained scum from surface			270,000
3rd March, 1905					8775
8th March, 1905	..	..	..	..	600
30th May, 1905	..	..	..	..	275
15th June, 1905	..	..	..	..	110
23rd June, 1905	..	..	..	..	550
27th June, 1905	..	..	..	..	100
12th July, 1905	..	..	..	..	170

Estimations made in Petri Dishes at Laboratory Temperature.

Medium used 1.5 % Neutral Agar, with Beef Extract.

N.B.—Optimum reaction with this water = Neutral

## APPENDIX VI.

LIST OF MICRO-ORGANISMS, OTHER THAN BACTERIA, FOUND  
IN THE LAGOON WATER, DURING THE PERIOD  
APRIL, 1904—JULY, 1905.

- DIATOMACEAE :— *Synedra ulna*, *Synedra pulchella*, *Nitzschia*,  
*Navicula*, *Asterionella*, *Tabellaria*, *Cocconeis*,  
*Himantidium*.
- CYANOPHYCEAE :— *Anabena*, *Glaucocapsa*, *Coelosphaerium*, *Micro-*  
*cystis*, *Oscillaria*, *Aphanocapsa*, *Lyngbya*.
- SCHIZOMYCETES :— *Crenothrix*, *Beggiatoa*.
- CHLOROPHYCEAE :— *Chlorococcum*, *Protococcus*, *Haematococcus*, *Scenedesmus*,  
*Coelastrum*, *Cosmarium*, *Palmella*, *Pandorina*, *Raphidium*, *Staurastrum*, *Conferva*,  
*Desmidium*, *Closterium*, *Volvox*, *Kirchneriella*,  
*Micrasterias*, *Ophiocytium*, *Pediastrum*, *Stauro-*  
*genia*, *Ulothrix*, *Xanthidium*, *Ankistrodesmus*,  
*Arthrodesmus*, *Botryococcus*, *Docidium*,  
*Sphaeroszoma*, *Gloeocystis*, *Dictyosphaerium*,  
*Dimorphococcus*, *Hyalotheca*, *Penium*, *Spirogyra*,  
*Stigeoclonium*, *Chaetophora*, *Zygnema*, *Micro-*  
*spora*.
- PROTOZOA :— *Peridinium*, *Dinobryon*, *Ceratium*, *Cryptomonas*,  
*Mallomonas*, *Vorticella*, *Chlamydomonas*, *Coleps*,  
*Enchelys*, *Euglena*, *Nassula*, *Paramecium*,  
*Phacus*.
- ROTIFERA :— *Anuraea*, *Rotifera*, *Asplanchna*, *Diglena*, *Triarthra*,  
*Notholca*.
- CRUSTACEA :— *Bosmina*, *Cyclops*, *Daphnia*, *Diaptomus*, *Sida*.
- OTHER ORGANISMS *Plumatella*, *Arcarina*, *Anguillula*, *Hydra*, *Spon-*  
*gilla*.

Those *italicised* occasionally observed in large numbers.

*Plumatella*, *Hydra* and *Spongilla* plentiful on wooden piles in lagoon,  
and in low pressure lengths of pipe.

## APPENDIX VII.

MONTHLY AVERAGE OF WEEKLY ANALYSES OF THE LAGOON WATER DRAWN FIVE FEET BELOW THE SURFACE.  
MAY, 1904 TO JULY, 1905.

Parts per Million.													
Date. 1904.	Temperature of Water. Deg. Fahr.	Ammonia.		Oxygen Consumed at 80deg. Fahr.		Nitrogen as Nitrates.	Chlorine.	Colour Platinum Boile.	Total Boils.	Colour Units.		Dissolved Oxygen per cent. of Saturation.	Bacteria per C.C.
		Free.	Albuminoid.	in 15 min.	in 4 hours.					Red.	Yellow.		
			Total.										
May ..	—	.04	.208	1.85	8.75	Nil		50	110				
June ..	57.6	.051	.208	1.80	8.53	"	83.8	53				75.6	
July ..	57.	.051	.204	1.49	5.95	"	83.7	41				58.5	
August ..	59.8	.050	.313	1.40	2.73	"	83.7	37				59.3	
September ..	67.2	.033	.299	1.18	2.50	"	83.5	33				75.1	
October ..	72.4	.043	.287	1.85	2.64	"	84.2	33					975
November ..	80.3	.053	.303	1.18	2.55	"	87.4	31		0.6	2.5		255
December ..	78.7	.034	.336	1.30	2.43	"	85.	31					105
1905.													260
January ..	79.7	.014	.260	1.35	2.75	"	87.1	30	108	0.8	3.3		
February ..	80.5	.043	.316	1.64	3.57	"	84.5		111	1.2	4.7		1100
March ..	79.1	.017	.267	2.14	3.97	"	83.7		114	1.3	4.4		600
April ..	74.7	.027	.323	1.90	3.37	"	85.5		115	0.9	3.5		
May ..	67.5	.023	.315	1.67	2.84	"	83.9			1.3	3.5		975
June ..	59.7	.06	.312	1.45	2.78	"	85.4			1.3	6.0		255
July ..	58.3	.01	.32	1.53	3.15	"	85.7		113	1.3	4.6		105

\* Grown on Gelatine.

N.B.—The lagoon was occasionally tested for Nitrogen existing as Nitrites, but in no case was any found.

The turbidity of the water was in most cases under 5 parts per million; and on only one occasion was it more than 20 parts per million.

## APPENDIX VIII.

## MONTHLY AVERAGES OF PER CENTAGE REDUCTION IN ORGANIC MATTER, COLOUR AND BACTERIA, EFFECTED BY PLAIN SAND FILTRATION.

1905.	Temperature.		Rate of Filtration. (Million gallons per acre per 24 hours.)	Ammonia.		Oxygen Consumed at 90deg. Fahr.		Colour. (Lovibond Scale.)		Bacteria. (Grown on neutral Agar medium.)
	Applied Water.	Effluent.		Free.	Albuminoid.	15 minutes.	4 hours.	Red.	Yellow.	
(1904)										
December (start)	81	80	2.1	100	31.8	23.8	26.2	nil	nil	
(1905)										
January	80	77.5	2.0	71	48.8	26.1	36.3	71.5	48.1	
February	80.5	77.7	1.9	76.7	58.8	34.5	40.2	98.2	65.9	99.1
March	79.1	77.6	2.0	11.7	57.0	38.4	38.7	55.9	33.2	96.0
April	74.7	73.7	2.1	82.8	42.7	41.2	37.2	100.0	61.1	
May	67.3	65.5	2.4	75.3	51.4	30.7	30.0	88.7	67.4	98.2
June	59.7	56.1	2.1	97.6	44.5	30.0	18.4	85.7	69.7	96.0
July	58.2	54.5	2.3	100.0	57.8	31.6	32.7	92.0	67.0	99.0
Average from 23/12/04 to 12/7/05			2.0	66.0	51.2	33.0	35.2	77.8	52.7	98.5

## APPENDIX IX.

## AVERAGE PER CENTAGE REDUCTION IN ORGANIC MATTER, COLOUR AND BACTERIA, EFFECTED BY THE VARIOUS TYPES OF FILTERS USED IN CONNECTION WITH THE EXPERIMENTAL PURIFICATION OF THE LAGOON WATER.

Type of Filter.	Period for which average reduction is calculated. Days.	Rate of Filtration (Million gallons per acre per 24 hours).	Average Percentage of Reduction.					
			Albuminoid. Ammonia.	Oxygen. Consumed.		Colour. Lovibond Tintometer		Bacteria. (Grown on neutral Agar medium).
				15 minutes.	4 hours.	Red.	Yellow.	
Morry Filter (sand & gravel)	139	2.1	54	40	39	93	67	91.8
Plain Sand Filter ..	183	2.0	53	33	36	93	66	98.5
Sand and Ashes ..	214	2.1	53.5	40	39	97	70	92.6
Machine Filter (Coagulants used) ..	80	104.0	56	57	41	—	—	—
Combination of Morry Fil- ter and Plain Sand Filter	17	2.2	59	35	42	100	68	97.3
Intermittent Plain Sand Filter ..	62	2.1	58	43	43	99	66	74.2

## APPENDIX X.

COMPARISON OF EFFLUENTS FROM A MECHANICAL FILTER  
AND AN INTERMITTENT PLAIN SAND FILTER, OBTAINED  
DURING PERIOD OF THREE MONTHS.

Average rate of filtration throughout period of test	}	Mechanical filter—104 million gallons per acre per 24 hours.
		Intermittent Sand Filter—2.23 million gallons per acre per 24 hours.

## AVERAGE RESULTS OF ANALYSES THROUGHOUT PERIOD OF TEST.

Parts per Million.	Albuminoid Ammonia.	Oxygen Consumed.			Colour Units.	
		Wanklyn.	15 mins.	4 hours.	Red.	Yellow.
Machine Filter, Applied						
Water .. .. .	.278	10.57	0.91	2.23	—	—
Effluent .. .. .	.123	5.76	0.39	1.32	—	—
Sand Filter, Applied Water	.322	—	2.00	3.62	1.1	4.1
Effluent .. .. .	.136	—	1.13	2.08	.01	1.4

COMPARISON OF AVERAGE PER CENTAGE REDUCTION IN  
ORGANIC MATTER EFFECTED BY MACHINE FILTER AND  
INTERMITTENT PLAIN SAND FILTER.

Per cent. Reduction.	Albuminoid Ammonia.	Oxygen Consumed.			Colour Units.	
		Wanklyn.	15 mins.	4 hours.	Red.	Yellow.
Machine Filter .. .. .	55.7	45.5	57.1	40.8	—	—
Sand Filter .. .. .	57.7	—	43.5	42.5	99.1	65.8

## APPENDIX XI.

ANALYSES OF SAMPLE OF LAGOON WATER COMPARED WITH  
FILTRATES FROM ANDERSON'S PROCESS.

Parts per Million.	Lagoon Water.	4 Minutes contact with Cast Iron Borings, Aeration, 48 hours Settle- ment, and Filtration through two thicknesses of Berzelius Filter Paper.	4 minutes contact with Cast Iron Borings, Aeration, 12 hours Settle- ment, and Filtration through three thicknesses of Berzelius Filter Paper.
Free Ammonia	.01	.04	.10
Albuminoid Ammonia	.32	.12	.207
Oxygen Con- sumed in 15 Minutes ..	1.58	.49	.88
Oxygen con- sumed in 4 hours ..	3.15	1.08	1.77
Iron (as Fe.) ..	.57	—	.055
Nitrogen as Nitrates ..	nil	nil	nil
Turbidity ..	nil	nil	very faint opalescence

## COLOUR—LOVIBOND—UNITS.

Red .. ..	1.3	nil	nil
Yellow .. ..	4.6.	0.3	0.5
Odour .. ..	d'ed'd sw'py	nil	nil

## APPENDIX XII.

BIOLOGICAL CONTENTS OF LAGOON WATER AT SURFACE NEAR  
OUTLET.

Date.	Depth.	Total Organisms per C.C. (not Bacteria).	Standard Units per C.C.
13/8/04		240	—
10/10/04		264	—
26/1/05		960	—
1/2/05		1040	—
8/2/05	Samples	1208	3175
16/2/05	collected	1060	1426
21/2/05	one foot	528	*3425
22/2/05	below	736	*3008
3/3/05	surface	596	1302
15/3/05		344	353
17/3/05		2960	*14908
4/4/05		840	1222
27/4/05		152	198

\*Samples marked thus contained some of the floating scum from the surface of the lagoon.



## APPENDIX XIII.

SHADE TEMPERATURE OF THE ATMOSPHERE AT THE LAGOON.  
(DEGREES FAHRENHEIT).

Period.	Average Daily Mean Temperature.
For month of July, 1904 .. .. .	55.3
August, 1904 .. .. .	56.1
September, 1904 .. .. .	61.7
October, 1904 .. .. .	68.7
November, 1904 .. .. .	72.7
December, 1904 .. .. .	75.8
January, 1905 .. .. .	79.5
February, 1905 .. .. .	78.3
March, 1905 .. .. .	74.9
April, 1905 .. .. .	71.2
May, 1905 .. .. .	61.0
June, 1905 .. .. .	55.8
Average Daily Mean Temperature for 12 months ..	67.0

## EXTREME TEMPERATURES FOR ABOVE PERIOD.

(DEGREES FAHRENHEIT)

Date.		
15th June, 1905	Lowest Minimum Temperature ..	32.0
15th June, 1905	Lowest Daily Mean Temperature ..	44.5
3rd January, 1905	Highest Maximum Temperature ..	113.0
5th January, 1905	Highest Daily Mean Temperature ..	93.0

**NOTE.**—The prevailing organism in the reservoir is described in this paper as *Protococcus*, because the dimensions of its cells correspond more closely with the dimensions of *Protococcus infusioformis*—*Rabenhorst* (aquatic form)—than with those of any other similar organism; the method of multiplication, by cell division, is also similar. In other respects, however, it agrees with descriptions of *Clathrocystis seruginosa*, *Hensley*; but I have never observed the thallus in clathrate form, it having been always either saccate or broken up into small fragments. The diameter of the cells is given for *C. seruginosa* as 2.5–3.5  $\mu$ , whilst the cells of our organism vary from 4.5–10  $\mu$ . Like *C. seruginosa*, it appears on the surface of the reservoir “as a bright green scum, sometimes glaucous, presenting to the naked eye a finely granular appearance, and when dried appearing like a crust of verdigris.” *Vide Cooke's British Freshwater Algae*. Professor Moebius found the organism—*C. seruginosa*—associated with *Peridinia* in water brought by pipes from this reservoir, and collected by Dr. Thos. L. Bancroft. *Vide Contributions to Queensland Flora*, by F. M. Bailey, F.L.S., 1893. The organism under discussion is always found associated with *Peridinia*, *Anabaena*, etc.

H.W.

**PROCEEDINGS**  
OF THE  
**Annual Meeting of Members,**

*HELD ON SATURDAY, 27th JANUARY, 1906.*

---

The Annual Meeting of Members was held at the Technical College, on Saturday, 27th January, 1906.

The President (J. Brownlie Henderson) occupied the chair.

The following Report of the Council and the Treasurer's Statement for the 1905 Session were read and adopted :—

*To the Members of the Royal Society of Queensland.*

Your Council have pleasure in submitting the report of the work done during the past Session.

Monthly Meetings.—Seven Monthly Meetings were held, at which the following papers were read :—

15th April—Some hitherto unknown manuscripts relating to the first French Republic, by S. B. J. Skeretchly.

27th May—A Disease Garden, by Dr. J. Thomson.

26th June—Paraguay, by John Lane.

5th August—A Typical Queensland Lagoon, and methods of purifying water for a town supply, by H. Wasteneys.

26th August—Java, by J. Brownlie Henderson.

25th September—The New Zealand Education System, by J. Shirley.

2nd November—Three-Colour Photography, by W. Saville Kent.

Three interim meetings were also held, at two of which the Hon. A. Norton gave exhibitions of lantern slides, and at one Mr. Shirley gave a lecture on Insects and Flowers.

New Members.—Eight members were elected during the year, namely: 27th May, J. C. Brunnich and H. Wasteneys; 5th August, R. M. Steele and W. E. Evans; 26th August, Henry Tryon; 25th September, Messrs. J. Cowan, F. E. Connah, and P. W. Jones.

The Council regret to record the death of two members, viz., the Hon. Sir A. C. Gregory, K.C.M.G., and the Right Hon. Sir H. M. Nelson, K.C.M.G. The first-named gentleman

was the first president of the Society, and was also one of the trustees. Sir Hugh Nelson was elected in 1898, when he paid a life-membership fee.

**Council Meetings.**—Eleven meetings of the Council took place, the attendance being as follows:—President, J. B. Henderson, F.I.C., F.C.S., 10; Vice-president, B. Dunstan, F.C.S., 6; Hon. Treasurer, Hon. A. Norton, M.L.C., 9; Hon. Secretary, J. F. Bailey, 11; Hon. Librarian, R. Illidge, 5. Members of Council: W. J. Byram, 5; J. Cameron, M.L.A., 8; C. J. Pound, 8; J. Shirley, B. Sc., 4; Dr. A. J. Turner, 8.

**Change in Council.**—Dr. J. Thomson was elected a member of the Council at the Annual Meeting, but subsequently resigned, and Dr. A. J. Turner was, at the February meeting, elected to the vacant seat.

**Nature Study Exhibition.**—From the 9th to the 12th of this month a Nature Study Exhibition was held at the Technical College. Thirteen schools entered, and a certificate was awarded for the best collection in each of the various sections. The Council wish to acknowledge the assistance received from Messrs. A. Exley and A. Johnston, the Teachers' Union representatives on the committee appointed to make arrangements in connection with the Exhibition.

In April last Vol. XIX., Part I., containing the papers read during the previous Session, was published and issued to members and the institutions on the exchange list.

A large number of donations have been received for the library from kindred societies and institutions.

**Treasurer's Statement.**—As usual, the Treasurer's Statement is furnished separately. It is to be regretted that so many subscriptions are in arrears, and it is hoped that those members in default will give attention to the matter. The library is sadly in need of funds, and it must be remembered that no subsidy from the Government was received during last year or the previous year.

J. BROWNLIE HENDERSON,

*President.*

BRISBANE, 27TH JANUARY, 1906.

J. F. BAILEY,

*Hon. Secretary.*

# THE ROYAL SOCIETY OF QUEENSLAND.

## FINANCIAL STATEMENT for the Year 1905.

Dr.

Cr.

RECEIPTS.			DISBURSEMENTS.			
£	s.	d.		£	s.	d.
Balance from last report ..	28	2 1	Rent ..	12	0 0	
Subscriptions ..	49	17 6	Printing and Stationery ..	24	16 0	
Sale of Proceedings ..	2	10 0	Postage and Petty Cash ..	7	15 4	
			International Catalogue ..	15	8 10	
			Advertising ..	5	10 0	
			Insurance ..	1	2 6	
			Bank Charges ..	0	10 0	
			Cheque Book ..	0	2 6	
			Typewriting ..	0	11 8	
			Balance—			
			Per Bank Book ..	10	6 1	
			Cheque in hand ..	2	2 0	
			Petty Cash in hand ..	0	4 8	

Liabilities, £6 18s. 8d.—Pole & Co., Printing, £4 19s. ; Treasury International Catalogue, £1 19s. 8d.  
*Brisbane, 18th January, 1906.*

Examined and found correct.

Geo. WATKINS, Hon. Auditor.

*Brisbane, 19th January, 1906*

A. NORRIS, Hon. Treasurer.

A vote of sympathy in the death of the Right Hon. Sir Hugh M. Nelson, K.C.M.G., was passed to Lady Nelson and family.

Dr. John Thomson was elected a Trustee in the place of the late Hon. Sir A. C. Gregory, K.C.M.G.

The retiring President (J. Brownlie Henderson, F.I.C., F.C.S.) then read the following address :—

### PRESIDENTIAL ADDRESS.

LADIES AND GENTLEMEN,—

Before going on with the principal subject of my address this evening, I would like to make a few remarks on the work of our Society during the past year.

On looking over the list of papers and lectures the first thing to strike one is the very small amount of original work that has been put on record.

It is extremely remarkable that in this new country with a field for research which is the envy of all European scientists, we ourselves do so very little original work and allow these outside scientists to step in and do most of the important researches. One of the causes is undoubtedly lack of education—our young people are blind to much of the world that lies around them and practically no attempt is made to give them sight. This phase I intend to deal with more fully later on. Still, in Queensland we have a number of scientific workers scattered up and down through the land—enthusiastic botanists, geologists, mineralogists, entomologists, etc., but who do not contribute anything to the Society's Proceedings, i.e., to the world's knowledge, as our Proceedings are exchanged with those of nearly 200 similar Societies all over the world. Is it entirely the fault of these workers that they are not connected with us? Would it not be worth our while to see if we are not partly or wholly to blame?

I think we would get a good response if we sent out notices to these workers, inviting them to help the Society in its efforts to add to mankind's knowledge of nature, and offering the Society's help to them by referring questions or specimens to standing sub-committees in the various sciences, and by publishing the results of their work. If Queenslanders only knew of the enormous fields for research

that lie open to them at their very doors and of the intense fascination of the search after such knowledge, we would hear a great deal less about the monotony of the Australian bush. Why, the bush simply teems with scientific facts waiting to be made known to a huge audience thirsty for the knowledge.

In the Old Country, the Royal Society's work largely depends on the use of expensive apparatus—natural history has been to a great extent worked out. But here in Queensland Natural History papers ought certainly to be sent in by hundreds, and yet they are comparatively few in number. I trust that ere long we will have far more work of this class entered in the records of the Society.

When the powers that be in Queensland wake up to the necessity of seriously fighting the various pests that tend to destroy our agricultural industry the scientists who take up the work will, I hope, find much of the life history of those pests already recorded in the Proceedings of the Royal Society. At present we have some such information collected, but the amount is very small indeed compared with what might be and ought to be on record.

I sincerely trust that my successor in office will find a change for the better in the amount of research work recorded during the year 1906, and that the present members of the Society will look through their observations for the last few years to see if they cannot find there some work worthy of a place in our Proceedings. I think it must rather be excessive modesty than excessive laziness that causes our Proceedings to contain the names of so very few members of the Society, seeing that many of them are continually at work in their special branches of study.

And now to the subject of the evening—

#### EDUCATION IN QUEENSLAND.

There is absolutely no need to apologise for introducing such a subject as education in the President's Address to this Society. I know it is much more common in Royal Societies to give a resume of the scientific research of the world during the past year in one or more branches of science, but it would be absurd for me to attempt such a task in Brisbane. It must be a very hard task indeed where there are many to help and first-class libraries to refer to, but here

with very few to help and practically no scientific libraries it would be an almost impossible task, even if but one science were taken, to give a full and accurate review.

I therefore chose a subject in which I have always taken a great deal of interest, and which I know is personally of very great interest indeed to many members of the Society, and also one which is of paramount importance to Queensland. Unless the subject of education soon receives a great deal more attention than it has done in the past, this Society will have to finish its existence. To realise this one has only to look at the list of names of contributors to the Proceedings, when it is seen that the native-born is conspicuous by his absence. This is not as it should be but it is a natural corollary to the present absence of any system of education in Queensland.

Before putting forward my views as to the directions in which I think we ought to proceed in our efforts to establish a system of education here, it would be well to take a rapid general view of the subject to see what has been done elsewhere in the past.

It is impossible to exaggerate the importance of a complete educational system to a nation. As Haldane says, "Educate your people, and you have reduced to comparatively insignificant dimensions the problems of temperance, of housing and of raising the condition of your masses. These things solve themselves if you only get the right spirit into your people." Many other thinkers have put the matter in a similarly strong way.

A nation's educational standard of to-day determines that nation's moral, literary and commercial standing of a few years after. To those who have studied the question, that is obvious, but unfortunately at no time has any Government in Queensland realised it. Yet far back in the world's history, centuries before the time of the Greeks, it was recognised by the thinkers that the national life was merely that of an aggregation of units—the higher and better the position of each unit, the higher and better must be the general status of the whole community. The most obvious method then to raise the nation to a high position was to train the children to reach what those in authority considered the highest type of man.

And it is just here that we can get the ideals of the leaders of those nations—by examining their method of preparing their young people for the business of life. The history of education is therefore a most fascinating study, revealing as it does how the leaders of the various nations that have come and gone across the centuries have looked at the future.

It is interesting to just look over a few of these ancient methods of education.

In India the Brahmans, since about 2000 B.C., have kept all education in their own hands. They were of pure Aryan blood and evidently introduced the caste system as a means of race preservation. They taught the young men (for females were never educated) sacred and heroic literature, poetry, rhetoric, grammar, law, medicine, theology, philosophy, mathematics, and astronomy. Most of the teaching was oral, and even lately text books were written so as to be easily committed to memory. The demand on the memory was very great indeed. The next two castes, the warriors and rulers, also could take the higher courses in the schools, but their training was much more on the lines of physical development. In 400 B.C. they had a comprehensive grammar of their own language, and their mathematics and astronomy were sufficient to enable them to calculate eclipses. The great mass of the people belonging to the lower castes were of course left in darkness—their education was illegal, as it is with the Javanese under Dutch rule at the present day. The Brahmans, who held the power, looked forward to keeping that power in their own hands as a class, and therefore carefully educated that class and no other. But their system tended only to develop metaphysicians, and as a natural result deterioration soon set in, and all over India progress ceased. Much of our learning seems to have come from or' through India: now the Western pupil has far outstripped the Eastern teacher.

The Aryans who settled in Persia were much more energetic than those who settled in India. They had a system of state education, but as before it was reserved for the children of the noble. And reading and writing formed no part of the systematic course! Their training was



mainly physical and moral. About the age of seven they left their homes and became attached to the king's, or other great man's court. They were then taught to be magnificent horsemen, to mount or dismount from a horse at the gallop, and to use the throwing spear and bow and arrow also while galloping at full speed. They were taken on long marches, subjected to extremes of heat and cold, and to scanty food. All this for physical training. Courage, truthfulness, gratitude and self-control were carefully inculcated, while rewards for services to the State were given, and State punishments inflicted, in their presence. So far as it went the training was splendid, but it was much too narrow. It made splendid noble warriors, but nothing more, and the warrior, after all, was essentially a robber and a murderer. He lived by conquest, and as riches and power increased, he as usual gradually deteriorated. Being only a very small section of the people the deterioration of this governing class was rapid and complete, and a few hundred years saw the end of the Empire.

The Persians in their systems of education neglected the sciences and arts, which were studied only by a few of the priests. The Egyptians on the other hand studied science deeply, and their searchings into nature gave them those magnificent views of life and death which are partly translated into stone in the temples and pyramids. Elementary schools where reading, writing, and arithmetic were taught, were private. The state did not control them and made no provision for the education of the masses. The priests were the educated class, and they conducted the higher schools in connection with the temples. It is astonishing that right down through the ages, even until the comparatively recent years of our Christian times, the learning and science were largely kept in the hands of the priests of the various nations. In these temple schools of the Egyptians, the principal studies were professional—architects, engineers and physicians being trained. The priests were trained for the priesthood in a more liberal way, the subjects including religion, morals, law, rhetoric, literature, astronomy, mathematics. Much of this learning was also imparted to the cultured upper class. But once more we have the record of the mass of the people being kept in

ignorance, and the decay of power and ability in the upper class could consequently not be made up by fresh strong recruits from the body of the people.

Little is known of the methods of education of the old Semitic nations, the Babylonians and Assyrians. There was certainly a well-educated class among them, and that class gathered together enormous libraries, the one at Nineveh containing at least 10,000 books. As the books treat of religion, law, literature, astronomy, mathematics, geography, plants and animals, the system had certainly done good work. One treatise on astronomy dates back nearly to 4,000 B.C. The Hebrew branch of the Semitic nations developed a system of education peculiar to themselves. It was a part of their religion, which was the noblest the world had ever seen. The Hebrews believed that all law—physical, moral, and legal—was an expression of the will of God, so that all their methods of education were necessarily concerned with their religion. They believed in the equality of man, of course in the general sense, and consequently every man had to be educated. We are all fairly familiar with the ancient Hebrew methods of education. It was laid down by law that parents must teach their children the laws of God, and though occasionally much neglected, that system has never been abandoned, and the obligation of parents to teach their children has undoubtedly done much to preserve what is best and noblest in Hebrew lives. Unfortunately little attempt was made beyond this—the Hebrew child was taught the highest moral law that the world had ever known. That was a magnificent start in life, but it did not tend to broaden or deepen the intellect. The priests and prophets had often schools in which were studied law, history, music and poetry, but higher education was practically non-existent. Later on in their history the scribes taught in the synagogues, and used a method of teaching which has been in existence until within recent years—the system of question and answer. It was used in giving instruction in the synagogue and elsewhere as being the method to which the people were accustomed by the Greatest Teacher of all time, the Christ. Seeing the results He obtained by it, one does not wonder at its almost universal acceptance by Christendom. The

Christian churches still have their "catechisms," and even elementary science text books were, until a few years ago, written in this form. The Hebrews had thus a splendid system of moral training, but it never went further. The leaders of the nation never seemed to awaken to the craving of a man's intellect for something more than a system of morality. The high position since taken by Hebrews in both sciences and arts shows to what heights their ancestors might have risen in these directions had they only made as much provision for education in that direction as say the Egyptians or Assyrians.

In ancient Greece there were two distinct types of people, and each devised a system of education typical of themselves. The Spartan, whose ideals rose little above that of making a man a perfect animal physically, trained the young with that end in view. Children if delicate when born were killed off by exposure. Those allowed to live, on attaining the age of seven were handed over to the state, placed in public institutions, brought up under the strictest discipline, and allowed nothing but the barest necessities in either food or clothing—the idea being to harden them for war. Physical culture was brought to a high state of development, and the girls were also trained till physically perfect, so that the women might be strong to bear strong children. The system of education somewhat resembled that of the Persians, producing a splendid warrior with a few splendid virtues, but owing to its narrowness it led to the extinction of the Spartan.

The Athenians on the other hand recognised that the mind makes the man more than the body, and in their system of education they aimed not at a glorified animal, but at a glorified mind in a vigorous body. Although physical training of the young held a very high place, it was put in its proper sphere as only a step in the scheme—not the end. The public schools where the physical and mental training were given were distinct. Music also held a very high place in their estimation, and was one of the most important subjects taught in the schools. In the secondary schools and in most of the schools of the philosophers, the physical sciences were taught in addition to the usual rhetoric, music, drawing, grammar, philosophy, etc.

The Grecian schools produced a greater number of great thinkers than those of any other nation before or since. But one thing they lacked—a recognition of the Hebrew ideas of God and righteousness. Morals to them were matters of expediency only, and though they rose in art and literature to what we still believe to be the highest point ever reached by the human race, in moral standard they were far below that of the ancient Hebrew.

The educational system of Rome, while founded on that of the Greeks, was adapted by them to their own special needs. At first the schools had no connection with the State, but as the Empire grew its leaders recognised the importance of training the youth of the nation, and the State then stepped in and supervised the work of training. After the elementary work, pupils were taught in secondary schools grammar, composition, music, rhetoric, etc., and occasionally geometry. At about 16 a youth would commence his professional training, and this like most things taken up by the Romans was done in a thoroughly practical manner. If intended for a military career, he became attached to the staff of a commander, if intended for a lawyer he joined himself to a jurist, if for a politician to some well-known orator. He could also study at the higher schools and later on at the Universities.

The University of Alexandria established in the third Century, B.C., was a great landmark in the history of education, and although so far from Rome became and remained the principle centre of education while the Empire lasted. It was a State endowed institution, and was splendidly equipped. It is not necessary here to go into its history, but it is a fact not generally realised that one of its earliest teachers, in the third Century, B.C., was as far as we know the first to calculate the magnitude of the earth by measuring an arc of the meridian. It was at the University of Alexandria and similar high schools that the Roman completed his studies. The Roman system was the best that the world had so far seen, but the corruption that ruined the Empire of course also ruined the schools. Perhaps it might be as accurate to state that the corruption which ruined the schools thereby ruined the Empire.

Such is a short history of the systems of education in force prior to Christianity. With the exception of the Hebrew system they were all intended for the classes, and the masses of the population were purposely left in ignorance.

Christ is not often regarded as an educational reformer, and yet His teaching of the brotherhood of man and His divine message that the ultimate measure of a man is his love for his fellowman, completely if slowly revolutionised the systems of education. Christ taught no detailed system of education of the young, as also He taught no system of theology for the adult. He swept aside all systems and replaced them by a grand general principle, leaving all special cases to be dealt with under that principle as they arose. And after many centuries the lesson has been absorbed and educational facilities are being provided in most Christian countries for all who have the ability to assimilate knowledge, instead of being practically confined to one class.

When the Christian religion replaced that of heathen Rome, several serious errors were made by those in authority. In their zeal for reform they cast out not only a most brutal, sensual and corrupt power, but with it much that was good and noble. They failed to distinguish between the art and learning of the heathen schools and the utter moral depravity that existed alongside. All were swept away together and it took centuries to regain the lost ground. In fact the evil seemed to recover its lost ground more quickly than the good.

The early Christians in their school system at first contented themselves with giving instruction in Christian doctrine—all else was neglected. Even in training for the ministry of the Church, little more than Scripture knowledge was at first required. National educational systems, if the education of one small class can be so called, were thus swept away, and were very inadequately replaced.

The monasticism of the ancient heathens soon took a hold on Christianity also, and gave a strong bent to education. Schools sprang up in connection with the monasteries all over Western Europe, and as the number of dialects far exceeded our present number of languages, Latin perforce became the language of the scholar. Some of the monastic

schools became famous, and it is interesting to note that one of the most famous was that of Columbia in the Island of Iona, the Irish monks from there spreading their knowledge all over Europe.

In one sense it was unfortunate that the monks held supreme control of education. Each monastery had its own methods, and there was no attempt at a national system of co-ordinated education. The monks' view of life was an extremely narrow one, and it, of course, colored their system of education. With several brilliant exceptions the monastic schools were of a rather low standing. Charles the Great saw the pressing need of education, even found fault with that of the monks, and strove to educate the laity as well as the clergy. The good work he did in this direction long survived him, the schools he had founded still remaining in existence long after his Empire was dismembered. Alfred the Great shortly afterwards did the same work for Great Britain, actually himself conducting a school at court for the sons of the nobles. All these schools however still had the monastic ideal, and advancement under that ideal was quite impossible. The monk glorified the soul and scorned and ill-treated the body. In the period known as the Age of Chivalry the knight arose in contrast to the monk. He glorified the body, and cared little for the soul and less for the mind. His education was simple, first as page and then as esquire. He was taught to scorn learning as a thing for monks, not for men, but in spite of that he had many manly virtues and served to preserve a balance against the monk at the other extreme. At the same time another development took place, the birth of modern conditions. Large towns gradually arose, and as a check to the power of nobles were granted by the sovereigns the right of self-government. In these towns the need was felt of an education totally distinct from that of the monk or the knight. As a result the first secular schools were founded and for the first time the native tongue was taught as a distinct subject.

Out of these monastic and other schools grew the educational triumph of the middle ages—the Universities. The first Universities were merely the result of great teachers arising in well-known schools, and by their ability increasing

the attendance of students till the numbers were so great as to demand special treatment. It is strange to read of the University of Paris, 700 years ago, having 20,000 students—nearly half the population of the city. Truly there was a thirst for knowledge displayed then that does not at present show itself in Queensland. Unfortunately the Universities were not part of any general national system, but still their power for good was so enormous that in all the changes that have taken place in those last 700 years, the old Universities still exist and live with greater vigor than ever. They marked the break away of the higher education from the government of religious or other control, and that too with the consent of the religious powers, for in the 12th Century, shortly after the growth of the episcopal school at Paris into a self-governing University, it received many privileges and gifts from the Pope. The Universities were also partly the outcome of the increasing power and wealth of the ordinary citizens, and the strong new life of the people fostered and was fostered by the Universities. The Universities naturally reacted on primary and secondary education, and they again on the Universities. With the Renaissance came another increase to the number of students, and also to the power of the Universities, and such a hold did the study of Latin and Greek then take, that a knowledge of one or both of these languages has been made compulsory in most Universities down to the present time for aspirants to degrees, even in subjects totally unconnected with anything mentioned in classical literature.

In Teutonic countries the revival in the study of the classics took a peculiar bent. The study of the New Testament in Greek led to a change in religious belief of many of the leading scholars, who induced their pupils to study the Bible in the original, and this was one of the principal causes that gradually led up to the Reformation. Zwingli and Luther were not only reformers of religion—they each helped to establish national systems of education. In holding that every man is responsible for his own religious beliefs, they had naturally to hold that he ought to be able to read and study the Bible for himself so that he might know what to believe. We talk of nature

study and new syllabuses. What would we think of reading, writing, arithmetic, scripture study, surveying, music, the classics and the study of objects in nature for mental work, and running, jumping, wrestling, and putting the shot for physical training? Somehow it sounds as if someone were advocating an advance on our present "syllabus," and yet it is an outline of what was advocated and used in Switzerland in 1520 by Zwingli. Luther strongly advocated compulsory education, pointing out the great danger to the State of allowing part of the population to grow up undisciplined. He advocated women as teachers, and pleaded with the Magistrates of the cities to spend more money on the schools. "Every year," he said, "the cities expend so much upon arms, roads, bridges, and numberless other things that contribute to their temporal peace and prosperity; should they not much more contribute as much for the employment of teachers for the poor youth so much in need of instruction." He also advocated in addition to the usual subjects "the study of nature," and a thorough course of physical training.

About this time the secondary classical schools sprang up, so that in Germany education became fairly well co-ordinated and the work ran through from primary to secondary, and then to University. Following on the establishment of the Reformers' schools, came the magnificent system of schools of the Counter Reformers—as represented by the Society of Jesus. They had in less than 150 years from their foundation over 200,000 scholars in splendidly organised schools, and to them belongs the credit of first definitely and thoroughly training teachers for their profession—a position not yet reached by us in Queensland.

The classical learning had barely become established when it was strongly attacked by skilful men, and these men too were among the greatest scholars of their time. Montaigne in France, Bacon and Mulcaster in England, and Ratich in Germany, all made strong attacks on the classical system, and advocated something new and better. Comenius, the Moravian, advocated a system which we still admire, and to some points of which we have not yet attained. The following sentence was not taken from a



late number of any educational gazette—it is 250 years old: “People must be taught to get their knowledge, as far as possible, not from books, but from earth and sky, from oaks and beeches.” Comenius’ system was magnificent—he looked to it to raise the whole nation to a higher plane; morally, mentally and physically.

Over 200 years ago, Francke, a German, who, like most of the world’s great school teachers was a minister of religion working for love of the people, established, among other schools and institutions, a secondary school. In it were taught German, Latin, Greek, Hebrew, French, arithmetic, geography, history, music, sketching, painting, mathematics, botany, anatomy, and the elements of medicine. It had a botanical garden attached, a physical laboratory, a chemical laboratory, a dissecting room for studying anatomy, a workshop with turning lathes and machines for grinding glass. What would not the Trustees of some of our so-called Technical Colleges give to put an educational feast of that sort before our knowledge-hungry youths. And yet the bill of fare is 200 years old.

The 17th Century saw science fairly established in the secondary schools and Universities, and in the beginning of the 18th century, the professors mostly ceased to lecture in Latin, and substituted the mother tongue. However, from our standpoint to-night, the greatest change in the 18th Century was in the number of elementary schools established, and the better acceptance of the principle that not only is education in itself a desirable thing, but that any nation which desires to hold its own in the struggle of life must insist on every citizen receiving a sound primary education, with special provision that all those who have the ability to benefit themselves and the nation by higher education, shall have opportunity given them to receive that education. As a result of the great advance made in the 18th Century, still greater advances were made in the 19th Century, and the necessity of free and compulsory education almost universally admitted and put in force. One of the most striking advances was made as a result of the crushing of Germany by Napoleon. In 1807, Frederick William III. and his councilors, defeated, ruined and crushed, sought a way of recovery. They hit upon a

plan which has made Prussia the leading power on the Continent of Europe—the education of the people. They instituted a complete system of compulsory state education which is still in existence, and which enabled them in less than 60 years to dominate both Austria and France in war, and is now seriously threatening to dominate England in commerce. France, even after the defeat of 1870, was badly provided with schools. As late as 1873, when the Prussian illiterate were under 1 per cent., more than 30 per cent. of the adult French population were entirely illiterate. The leaders of the nation then recognised the national danger and the way out. They followed Prussia's example, and in a few years had in working order what has been characterised as the most thorough and comprehensive school system in the world. By 1895, 91 per cent. of all the children in France attended school regularly.

Along with this enormous increase in the number of pupils in the primary schools, came an increased demand for secondary technical schools, and these are now firmly established on a good basis in several countries. There also came with this increased activity a radical change in the methods of teaching, most of which had been outlined long ago. It is not my intention to discuss these methods in detail this evening, though some of them, such as the kindergarten, could well be adopted in Queensland. Such details are matters of consideration for experienced teachers themselves.

I have briefly given these few facts as to the growth of educational ideas, so that we may be better able to judge as to whether we are doing in Queensland what we might be doing.

I think I might shortly sum up educational facilities in Queensland as follows:—We have, considering the small population that is spread over such a large area, a very fair proportion of primary schools. The subjects taught in these schools are reading, writing, arithmetic, grammar, history, geography, drawing and music, and for the girls, needlework. In the larger schools a few elementary science subjects are also taught, and there has lately been added to the syllabus the hundreds of years old subject—nature study. So far as it goes, our elementary education is good—

at least when compared with similar elementary courses of study elsewhere. In addition to our elementary State schools, we have several other schools called Grammar Schools in six of the principal towns. These are not worked by the Education Department, but each is under its own Trustees, gets an endowment from the Government and establishes what courses of study it pleases. That the work of the Grammar Schools is well up to that of similar institutions in the Southern States we all know, and it is shown by the results of the Sydney University senior and junior examinations. Unfortunately the Grammar Schools, not being under the control of the Education Department, are doing a good deal of the work that is also done in the State Schools, and so are not proper continuation schools. As they aim largely at preparing students for the Universities they have perforce to retain the ancient classical learning as one of the principal parts of the school curriculum. We have no higher education provided than is supplied by the Grammar Schools.

In another direction, education here has been struggling along under difficulties. Some years ago, in several of the larger towns, institutions called Technical Colleges were established, to encourage which the pupils' fees were subsidised to an equal amount by the Government. This subsidy has in the last few lean years been considerably reduced. In quite a number of the colleges no applied science whatever is taught. Such colleges are merely commercial schools where shorthand, type-writing, and probably dressmaking covers the entire number of subjects. In one or two of the larger colleges attempts have been made to establish physical and chemical laboratories, but the lack of funds has prevented any of the college authorities, however much they wish it, from establishing well-fitted physical or chemical laboratories or engineering workshops. Great credit is deserved by those who, in the face of all difficulties, have established such laboratories as we have now. While the name Technical College has perhaps no definite meaning, the Technical Colleges of Queensland, except in the case of a very few classes, do not reach the standard of the secondary science schools of England and Scotland. Apart from these

Technical Colleges there are two educational institutions which are entirely controlled by the Government—the Agricultural College at Gatton, and the School of Mines at Charters Towers. Both are doing good work, but both are sadly hampered by lack of funds. That briefly summarises the educational facilities provided or subsidised by the State in Queensland, and I am safe in saying that none of the few private schools reach so high a standard as the Grammar Schools. The total State provision for higher education consists in three exhibitions granted every year (worth £100 a year for 3 years) to enable the holder to attend a Southern University. Three exhibitions per annum for half-a-million people! About 14,000 children are born every year in Queensland, and three of them are to be fully educated! I know that these statements are familiar facts to nearly all present, but although the facts have been on several occasions put before the general public, the facts are not known—that is, the general public does not realise what a serious menace to Queensland is the total absence of any co-ordinated system of education. Will not some of our legislators who recognise this great danger (and I know that some of them do) start a campaign in favor of a complete educational system for Queensland. In spite of all that is said about politicians in general, I think there is quite enough patriotism in the Queensland Parliament to prevent the subject of education entering the sphere of party politics and thereby probably receiving more harm than good.

A good supply of primary state schools, several Grammar Schools, not connected in any way with the State Schools, several Technical Colleges, also practically independent, where much revision work has to be done owing to the students having partly forgotten their primary education, a School of Mines away in the North, working under the same lack of connection with primary and also, secondary education, an Agricultural College, also disconnected, and lastly three pupils per annum sent South!

When will some strong man arise, and co-ordinate and bring into working order all these independent educational forces. Where is the sense in spending so much money

on secondary education that means, as we have so few rich residents in Queensland, that only about 3 per annum of all these students are going to complete their work? Why go on so far only to drop practically everything? The answer that has hitherto been received is generally that it would cost too much. But it would cost nothing, and possibly result in a saving of money and certainly of the pupils' time, were the work of the Grammar Schools made as strictly continuous as possible on that of the primary State Schools, and students entering the public or State Technical institutions required to show their fitness to partake of the mental food presented. Such a course has been found necessary elsewhere, and will, I trust, soon be adopted here. It would be a very great mistake indeed to attempt to put on the crown of all educational systems—the University, ere the primary and secondary schools were properly correlated. With primary and secondary schools in working order the establishment of the University would be greatly facilitated. We would have hundreds of students ready to take advantage of the University immediately it was opened.

Very many hard words have been used against past Governments for refusing to go to the expense of establishing a University. I suppose they were deserved, as the enormous benefits to be derived by Queensland from a University would completely justify any Government in spending the money. But in one way the Governments had a very good excuse indeed for not spending the money. There has never been a general demand by the people for a University, and knowing that, successive Governments have refused to take action. We are sadly in want of a Horace Mann in Queensland, some one who will go round, as he did in Massachusetts, U.S.A., finding everywhere absolute apathy and unconcern as to educational facilities, and leaving behind him boundless energy and enthusiasm in the good cause. Once open the eyes of the people of Queensland to the danger of the future through bringing up our young people practically uneducated, to compete with the trained skill of the foreigner, and the University question will solve itself. Any Government that got a mandate from the people to complete the system of State

education would gladly supply the necessary funds and do the work. The raising of the funds could be done as in America and elsewhere, by selling State lands, or by direct taxation, and I am certain that an educational tax would be as little unpopular as it is possible for a tax to be. The incidence of the tax could best be decided by those experienced in such matters, but for this object the ancient and venerable tax on bachelors might be hinted at as a fruitful and of recent years unexploited field.

And now having summarised what is being done in Queensland, I would like to make a few suggestions as to what I think are weak points in our present methods. And first of all let me state clearly that I do not desire to make any reflections whatever on our Education Department. Any one who knows anything of Queensland and its back-blocks, and its far North, can have nothing but admiration for the educated men and women who go there and endure the extremes of heat and drought and isolation, without any prospect of "making a pile." No teachers in the British Empire have, I believe, more hardships to endure than those in Queensland, and none endure them more cheerfully. And the Department in its new syllabus has certainly taken a step in the right direction, and is probably now as far advanced in primary education as any of the Southern States, except in one point—the training of the teachers. At our late Nature Study exhibition, one of the senior teachers remarked to me, with reference to Nature Study, "I know nothing about natural sciences, and so far as I can see, neither do any of my assistants, although some of them are reading it up. How am I to supervise them or teach Nature Study myself?" That is the weak spot in the scheme. A new subject has been introduced, few of the teachers have previous knowledge of it, and now they have to teach it. That is one of the arguments in favour of a training college, if arguments are required for such an obvious necessity, and the establishing of the University would at once supply the greatest need of the teachers of Queensland. The question sometimes forces itself on one, are all these States going on the right road to education? What do we ultimately aim at? Why this enormous annual expenditure? I suppose we expect that by our

system we will not only prevent the race from deteriorating, but that our system will carry succeeding generations to higher levels, physically, mentally and morally than we ourselves have attained. Is the boy who leaves the State School to-day physically superior to the boy who left it 30 years ago? I am afraid not. It is staggering to think that because the known systems of physical culture have not been adopted, our boys and girls are growing up with only half their proper share of health and strength. If it is true, and some of the best authorities say that they have actually proved it in practice, that one hour per day, if systematically devoted to physical culture, will thoroughly develop the frame, then why is it not done? Take a walk along any of the principal streets of any of our Queensland towns, and look at the physique of the youths. Any one will admit, I think, that the average is certainly not better than that of the youths of the old country towns, and in some of the towns it is as certainly inferior. If there lies to our hands a method of making the children grow up much stronger and healthier physically and we do not use it, then our neglect is absolutely criminal. Either the advocates of physical culture are deliberately misleading us, or our authorities are, by their neglect, laying up a store of weakness and sickness and resultant criminality. Ability to extract a cube root is of much less importance than a well-developed healthy body, and an hour per day, or even half the day, if taken from other pursuits would be well spent indeed in laying up a store of health and strength.

There is one other point in which I think our system is woefully defective—in religious training. This is recognised by men of every branch of the Christian religion, but unfortunately none have so far suggested a practical remedy. In an old settled community the lack of religious instruction in the State Schools is not felt quite so much—there are other sources of that instruction. The old spirit which made Churchmen everlastingly harp on their points of difference is fortunately giving way to a more rational spirit, and they are now showing a tendency to find out the points on which they agree. As they are all nominally believers of Christ's teachings, it should surely be possible for them soon to agree to similarly interpret a sufficient

number of His sayings to form a course of lessons from which dogma and "isms" would be entirely absent. Owing to the power of the Churches, until that is done, possibly the best course to pursue is the present one—let religion alone in the State School. If there is one statement more than another that has been borne out by history, it is the thousands of years old one, that "Righteousness exalteth a nation." The Spartans pinned their faith to a sound body but they soon perished. The Athenians developed both mind and body—were possibly the most highly cultured race the world has ever seen—yet it did not save them from the vilest immorality and debauchery, and final extinction as a nation. In the middle ages the rulers of the nations tried ignorance as a method of keeping the nation together; they had a few educated thinkers and rulers, and all the remainder workers who were not on any account to think. But that also failed. Solomon was right, "Righteousness exalteth a nation," and nothing else will. Yet thousands of our children are growing up with practically no moral training. "Thou shalt not be found out," is the only commandment they are taught to respect. It is just as impossible to develop the moral as it is to develop the mental side of human nature without any training. I consider it one of the darkest outlooks for our Commonwealth that so many thousands of children are coming to maturity with undeveloped or blunted moral perceptions.

The very small amount of time devoted to moral and physical development of our children I look on as the most serious defects of our State primary education. The subjects of the syllabus I consider a matter of much smaller importance. A good teacher will educate with almost any subject, and a bad teacher will not educate with the best subjects. The training of the teachers is of far greater importance than the items of the syllabus. Of course there are some subjects of more importance than others, and it seems absurd to an onlooker to see history and geography taught while physiology and dietetics are avoided. A very slender knowledge of foods would probably have a marked effect in lowering the infantile death rate. It shocks one to hear from medical men of the awful yearly sacrifice of infants through improper feeding. It is largely



preventable, being solely the result of ignorance. It is an established fact that proper mastication and insalivation of all food practically prevents indigestion, which is the cause of nearly all disease. Yet this fact, which if properly instilled into children would vastly improve the race, is ignored and instead they are thoroughly drilled in such lists as the names of the principal capes in England!

One other point in the State control of education is badly neglected. We officially test lawyers, and dentists and State school teachers and others ere they practise, and yet we allow anyone who pleases to start a private school and charge the public presumably for education supplied. The education of any people is of quite sufficient importance to justify the State in seeing that all who take part in it are qualified for the positions they take up either in State or private schools.

I have already pointed out that the State does not control the subjects or methods in the small amount of secondary education provided. It is therefore not much use to criticise them, but I would like to point out that the classical education still holds pride of place in the Grammar Schools, and commercial education in the Technical Colleges. As the Head Master of the leading Grammar School has often pointed out, the Southern Universities determine the subjects taught in our Grammar Schools, so until we provide a University of our own we must needs, at least for students intending to go South, accept their lists of subjects. I sincerely trust that when the University is established here, no foreign language, dead or alive, will be listed as compulsory in the matriculation, and that to obtain degrees in any one branch of knowledge it will not be necessary to show a knowledge of subjects in a totally distinct branch of knowledge. One of the most famous Professors of Edinburgh University, failed to take his arts—which is a literary—degree, because his brain was not built on mathematical lines and he failed to pass in mathematics. Why should he have been deprived of a degree that required brain power of one kind, because he had not brain power of a totally different kind?

While I would be sorry to see the classics entirely omitted from our educational system, I trust they

will never be made compulsory. A University for a new country with no leisured class who have little else to do than amuse themselves, should give a distinctly practical bent to education. The technical side of higher education, such as medicine and surgery, engineering subjects, chemistry in its application to agriculture, mining, metallurgy, etc., and those other branches of knowledge of natural science the application of which tends to the betterment of our people, will I trust take first place.

The cost of starting a University here has often been much over-estimated. Undoubtedly £200,000 could be spent on buildings and fittings without wasting a penny. But a start could be made without other buildings than we have at present. The Wellington branch of the New Zealand University when I was in Wellington two years ago, consisted of the teaching staff. They had no buildings, though these were approved and the site cleared for their erection. But a first-class teaching staff had been appointed, and the classes met where rooms were available—which meant in different quarters of the town. The chemistry was taught by arrangement with the local Technical College in their Laboratory, and though the Laboratory could not be called a first-class one, and the equipment was inexpensive, some of the most striking recent contributions to chemical science have come from there in the last few years. The appointment of say four first-class men, with a few assistants and a comparatively small initial outlay for apparatus for physical and chemical laboratories would start a University in Brisbane. We do not require a great outlay on buildings at the beginning, but we want the teaching to be the best obtainable.

And look at the advantages to be gained from a commercial standpoint—for that is evidently the view that will be taken by those who supply the funds. At present if a scientific man is required in Queensland we instantly send elsewhere for one. It is not because the young Queenslanders are less capable than the young Englishman. So far as my observation goes the average boy here is smarter and quicker, if perhaps a little less tenacious, than the boy in the Old Country. It is merely that the young Queenslanders have never had a chance. I have known boys here

show most exceptional aptitude for science. Had there been an educational system they might have become leaders in pure science, or have devised newer and cheaper methods of treating our ores. One I remember in particular, whose appetite for science was insatiable, failed to get an Annual Exhibition because he could not stew up Latin and Greek sufficiently well, and the marks given in that examination for these subjects were out of all proportion to their importance. That young man is now a clerk in an office. To take another view. We are trying to establish several secondary industries here. I have often been interviewed by individuals engaged in these industries, and the ignorance they show of the foundation principles of their trades is only equalled by their courage and perseverance. Some time ago a man brought to me an article he had manufactured. He said it contained about 14 % of a certain constituent. He was basing his calculations on that, but wanted to make quite sure. It contained 34 %. Another manufacturer of the same article, when asked, stated he did not know how much was in his—he thought about 20 %—but there was over 30 %. Now a comparatively elementary knowledge of practical chemistry, such as would be obtained in second year's chemistry at a University would have sufficed to put these men right. Where the educational system is good, such small manufacturers easily get a man to do all their clerical and chemical work, and the saving is enormous. Until skilled labor is cheap Queensland's secondary industries will not thrive, and skilled labor will not be cheap until we get a modern University. Had one tenth part of the famous £10,000,000 loan, been devoted to establishing a complete educational system, we would not still have been waiting for outsiders to show us how to develop our magnificent mineral resources. Young Queenslanders would have been discovering and turning out copper, tin, lead, and other metals by the thousands of tons, and Queensland would have already occupied the position to which she will one day attain—the wealthiest mineral State in Australasia, and one of the greatest if not the greatest mineral producer in the world. £1,000,000 invested then in that way would by this time have given returns in actual cash worth the whole loan.

The advantages of a University from a higher standpoint have been so often proclaimed that it is needless for me to repeat them to-night.

One is tempted to look forward and try to show some of the results of better education. Try to picture Brisbane if governed by men who had been well trained in public health. No more would be heard of our present foul "sanitary" system, or of foods manufactured solely to sell—not for providing nourishment. It is undoubtedly only a matter of education (which is in this case "time") until we will force all candidates for civic honors to prove by passing a non-competitive qualifying examination that they know sufficient about finance, public health, and similar subjects to justify the citizens in putting them in charge of their city. We would then have a proper system of drainage, a drinkable water supply, a freedom from plague, etc., and I have no doubt, a smaller overdraft. The same thing will apply in the future to politicians. I feel certain that a well-educated people will demand from any man who proposes to make their laws and govern them some proof of his competency to do so. I do not suggest a literary standard but a qualifying examination before nomination, on the principles of Government as applicable to our local conditions. We do it in every other profession—why not in that profession which should be the noblest of all?

It is also a question of only a few years till education will cause the present barbarous system of war to be abandoned. It is against the laws of nations to kill by shells containing poisonous gases. Why? Would it not be infinitely more humane to fire shells loaded with a gas, which if it did not kill (and that painlessly) outright would leave men strong and well as ever, than to fire shrapnel which smashes and maims and tears and leaves what was a man a hideous mass of torn flesh, and even when it only wounds leaves men maimed for life? That old professional soldier, the knight, objected to the introduction of firearms; it spoiled his sport and made war more, instead of less, dangerous to him than to the ordinary soldier. The modern European military expert objects to gases which would kill without maiming or leaving any wound because it would spoil war from his standpoint. Instead of being

an exciting game with one chance in a hundred of being killed, he would have about ninety-nine chances of being killed. It certainly would make war as now conducted impossible. With a comparatively few shells filled with suitable compressed gas and suitable big guns to throw them, 50 men could annihilate an army. And why should they not do so? War is wholesale murder, so if it is to be murder let it be done as quickly and painlessly as possible. I trust that some great nation will soon give notice that if any other power attacks it this method will be used in defence. That will do more to end war than all the peace conferences that could be held in 100 years. It would look wasteful to throw so many millions of pounds worth of war material on the scrap heap, but better throw the money there than the men.

Much more might be said on the benefits of thorough education—its “socialistic” tendency (not in the political partisan sense) and in a hundred other ways.

I have tried, in however imperfect a way, to show the very backward position in which we are in Queensland with regard to education. I have quoted no statistics as to money spent elsewhere. We have heard and read those over and over again. I would like again to say in reply to the hackneyed cry of our poverty as our excuse that it is because we have no system of education that we are poor. What nations have now the best educational system? Undoubtedly Germany and America, and they are also making greatest progress in commerce. New Zealand has the best educational system in Australasia, and New Zealand is the most prosperous State in Australasia. Can anyone honestly say that we, the richest State in the world if we consider the natural resources per head of population, cannot raise even £10,000 a year for a University?

I think I have said quite sufficient to show that not only is the scholar interested in the establishment of a University, but that it is a matter of the deepest concern to every one in the State; and not only to establish it as part of a system, but to see that provision is made that every youth in Queensland who has shown capacity for receiving a higher education shall have opportunity given to receive the best education that can possibly be provided. Poverty

must always be a hindrance to the education of a budding genius, but in the interests of the State such provision ought to be made that poverty, while it may demand increased exertion, will not debar any capable youth from having his gifts developed by a first-class education. And such a complete system of education young Queenslanders should not request as a favor from anyone, but should demand as their rightful heritage, as something that should be theirs, something that is being cheerfully given to their more fortunate brothers and sisters in other parts of the empire, and without which Queensland and Queenslanders must be left far behind in the rapid advance being made under modern educational methods in all civilised countries.

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A vote of thanks to Mr. Henderson was carried by acclamation.

A paper by J. Douglas Ogilby, entitled "Symbranchiate and Apodal Fishes new to Australia," was laid on the table and taken as read.

The election of office-bearers for the year 1906 resulted as follows:—*President*, Benjamin Dunstan, F.G.S.; *Vice-President*, A. Jefferis Turner, M.D.; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Secretary*, F. E. Connah; *Hon. Librarian*, R. Illidge; *Members of Council*, J. F. Bailey, W. J. Byram, John Cameron, M.L.A., J. Shirley, B. Sc., and John Thomson, M.B.; *Hon. Auditor*, George Watkins; *Hon. Lunternist*, A. G. Jackson.

The new President was conducted to the chair, and after returning thanks for his election, the proceedings terminated.

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END OF VOLUME XIX.

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# PROCEEDINGS

OF THE

# ROYAL SOCIETY

OF

# QUEENSLAND.

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**VOLUME XX.**

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PRINTED FOR THE SOCIETY

BY

H. POLE & CO., PRINTERS, ELIZABETH STREET, BRISBANE.

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THE  
**Royal Society of Queensland.**

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HIS EXCELLENCY LORD CHELMSFORD.

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# CONTENTS.

---

	PAGE
SYMBRANCHIATE AND APODAL FISHES NEW TO AUSTRALIA.— <i>J. Douglas Ogilby</i> , January 27th, 1906                   ...           ...           ...	1
SOME NEW PEDICULATE FISHES.— <i>J. Douglas Ogilby</i> , April 2nd, 1906           ...           ...	17
NOTES ON EXHIBITS.— <i>J. Douglas Ogilby</i> , March 5th, 1906...           ...           ...           ...	27
A NEW TREE FROG FROM BRISBANE.— <i>J. Douglas Ogilby</i> , April 2nd, 1906           ...           ...	31
NOTES ON LEPIDOPTERA. FROM THE VICINITY OF BRISBANE, THE LARVÆ OF WHICH FEED ON LORANTHUS.— <i>R. Illidge</i> , March 5th, 1906           ...	33
ON A NEW TERAPON, FROM THE STANTHORPE DISTRICT, SOUTHERN QUEENSLAND.— <i>J. Douglas Ogilby</i> , August 31st, 1906           ...           ...	37
MENTAL DEVELOPMENT IN ANIMALS.— <i>Hon. A. Norton, M.L.C.</i> , October 4th, 1906...           ...	41
NOTES ON AN APPARENTLY NEW SPECIES OF HYALINE DAPHNIA.— <i>W. R. Colledge</i> , October 27th, 1905           ...           ...           ...	53
QUEENSLAND GEMS.— <i>Major J. R. Sankey</i> , De- cember 22nd, 1906...           ...           ...	61

# SYMBRANCHIATE AND APODAL FISHES NEW TO AUSTRALIA.

By J. DOUGLAS OGILBY.

[Read before the Royal Society of Queensland,  
January 27, 1906.]

IN the following pages will be found full descriptions of three additions to the fish-fauna of Australia. These are : (1) The very interesting symbranch *Amphipnous cuchia*, not hitherto recorded east of Burmah, but now described from a Queensland specimen. The small order to which this fish belongs is, however, well represented in our waters by one, perhaps two, species of *Chilobranchus* and a *Symbranchus*. (2) A moringuid from North Australian waters belonging to the genus *Aphthalmichthys*, which I am constrained to describe as new, since it is in many respects intermediate between the typical vermiform *A. javanicus* and the more robust *A. abbreviatus*. And (3) a murænid, the easterly limit of whose range has so far been given as Java, but of which we have now two fine specimens from the rivers flowing into Moreton Bay.

## ORDER SYMBRANCHIA.

### THE SINGLE-SLIT EELS.

BODY anguilliform. Scales small or absent. Premaxillary, maxillary, and palatine elements well developed and distinct from one another, the first constituting the entire outer margin of the upper jaw. Opercular apparatus complete. Gill-openings inferior, confluent in a single slit; accessory branchial organs sometimes present. Vertical fins vestigiary, reduced to folds of the skin; no paired fins. Vent posterior. Cranium with the bones firmly united; a pair of exoccipital condyles. Symplectic bone

present or absent. Supraoccipital separated from the frontals by the parietals. Shoulder-girdle typically connected with the cranium; no mesocoracoid. Vertebrae numerous, the anterior not modified. Ribs present. No air-bladder, nor pyloric coeca. Ovaries with oviducts (σύν, together; βράγχα, gills: in allusion to the confluence of the gill-openings).

Fresh and brackish waters of India and Burmah, ranging northward to Korea and Japan, and eastward through the Malay Archipelago to Australia and Tasmania; one species from intertropical America. Four families, one of them exclusively marine.

The SYMBRANCHIA form a small order of eel-like fishes of widely diversified structure *inter se*. They have been separated by the late Professor Cope into two suborders, which, with certain necessary modifications originally pointed out by Dr. Gill, are here adopted. Jordan and Evermann (Fishes of North and Middle America, part i, p. 342) remark of them:—"They are probably related to the *Apodes*, but this is not certain, and in the structure of the head they approach more nearly to the true fishes. They represent degraded rather than primitive types, and the line of their descent is as yet unknown. It is not even certain that the forms grouped in this order are closely related." From this it will, therefore, be readily understood that the members of this order form a peculiarly interesting and instructive group. Three out of the four symbranchoid families have now been shown to inhabit Australian waters, while the inclusion of the fourth is probably a mere matter of time.

The principal differences between the *Symbranchia* and the *Apodes* are given below in parallel columns:—

SYMBRANCHIA	APODES.
Premaxillaries present, forming the lateral dentigerous border of the upper jaw; the maxillaries distinct, lying along their inner edge.	Premaxillaries absent or atrophied, the maxillaries forming the lateral dentigerous border of the upper jaw.
Gill-openings confluent across the throat.	Gill-openings separate, lateral (except in the <i>Synaphobranchidae</i> ).
Shoulder-girdle typically connected with the cranium.	Shoulder-girdle not connected with the cranium.

The *Synphobranchidæ*, mentioned above, form a small group of deep-sea eels from the Atlantic and Pacific Oceans. They agree with the symbranchiids superficially in having inferior, externally confluent gill-openings, but may always be recognised by the presence of a rayed dorsal and anal fin, well developed pectorals, and an anteriorly situated vent.

Appended is an analysis of the families of the *Symbranchia* :—

- a. Body scaleless ; no accessory branchial apparatus ; shoulder-girdle connected with the skull by an osseous bifurcate post-temporal (*Ichthycephali*).
  - b. Gill-membranes free from the isthmus ; gill-arches four, the fringes well developed.
    - c. No palatine teeth ; vent in the anterior half of the length. Monotypic. . . . . i. CHILOBRANCHIDÆ.
    - cc. Palatine teeth present ; vent in the posterior half of the length. Monotypic. . . . . ii. SYMBRANCHIDÆ.
  - bb. Gill-membranes almost wholly united to the isthmus ; gill-arches three, the fringes rudimentary ; palatine teeth small, in a narrow band ; vent in the posterior half of the length. Monotypic. . . . . iii. MONOPTERIDÆ.
- aa. Body scaly ; an accessory branchial apparatus ; shoulder-girdle without osseous connection with the skull. (*Holostomi*).
  - d. Gill-membranes almost wholly united to the isthmus ; gill-arches three, separated by narrow slits, the fringes rudimentary ; palatine teeth stout, uniserial ; vent in the posterior half of the length. Monotypic. . . . . iv. AMPHIPNOIDÆ.

#### AMPHIPNOIDÆ.

Body anguilliform, covered with minute scales, which are arranged in longitudinal series. Head moderate, the snout very short and blunt. Mouth anterior, with wide, oblique cleft. Upper jaw with several transverse series of small teeth anteriorly, the lateral teeth uniserial ; palatine teeth in a single row, stout, blunt, recurved, and compressed ; mandibular teeth similar to but rather larger than those of the maxillary. Anterior nostril minute, above the front margin of the eye ; posterior valvular, behind its middle. Eye very small, superolateral. Gill-membranes united, almost wholly attached to the isthmus ; gill-openings reduced to a confluent slit, situated on the ventral surface ; gill-arches three, separated by narrow slits,



the branchial lamellæ<sup>1</sup> rudimentary; accessory breathing apparatus present, communicating with the gill-cavity; branchiostegals six. Vertical fins rudimentary, reduced to more or less distinct folds of the skin; no paired fins. Vent situated in the posterior half of the length. Cranium short, not protecting the entire branchial apparatus. Shoulder-girdle not attached to the cranium by a bony process.<sup>2</sup> Vertebrae—*fide* Günther—106+65=171

Fresh and brackish waters of the Punjab, extending to Bengal, Orissa, Assam, and Burmah (Day). Eastern Queensland. Monotypic.

Since it is by means of these lamellæ that the water, inhaled by all gill-bearing animals, whether larval or adult, is deoxygenated previous to its expulsion at the gill-openings, it will be easily understood that the absence or degradation of these organs, unless invalidated by some counterbalancing provision, is a matter of very serious moment to such an animal; of so great moment, indeed, that if we were to take a freshly caught fish, and having carefully removed with a pair of scissors the delicate filaments which fringe the outer edge of the gill-arches, return it in all its seemingly pristine vigor to its native element, but few moments would elapse before it began to exhibit all the symptoms of asphyxiation, and death would shortly result. In the case of *Amphipnous*, however, the difficulty is met by the provision of an accessory breathing apparatus, which communicates directly with the gill-cavity and enables the fish to absorb atmospheric air by a simple act of suspiration; its dependence on this organ is easily demonstrable by placing the fish in a glass jar, the mouth of which has been closed by a piece of gauze or fine wire netting; if this be sunk beneath the surface so as to deny all access to the air,

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<sup>1</sup>Taylor (Gleanings in Science ii, p. 173), referring to these lamellæ, informs us that the second gill-arch alone possesses them in the shape of "a few long fibrils attached to the middle of the arch, and occupying but a very small extent of its surface," while "the third supports in the place of laminae a thick and semitransparent tissue, which in large individuals of the species possesses a fringed or denticulated appearance on its edge."

<sup>2</sup>Günther (Catal. Fish., viii, p. 13) describes the posttemporal as being "very small and cartilaginous, continued into a muscle, which is attached to the skull."

asphyxiation will supervene so soon as the supply of atmospheric air contained in the gular reservoirs becomes exhausted, and the fish will perish, just as you or I would were we unfortunately placed in a similar predicament, as for instance in a damaged submarine.

#### AMPHIPNOUS.

- Amphipnous*, Müller, Abhandl. Akad. Berlin, 1839, p. 244 (*cuchia*).  
*Ophichthys*, Swainson, Nat. Hist. Classif. Fish, ii, p. 336, 1839 (*punctatus* = *cuchia*); not *Ophichthus*, Ahl, 1789.  
*Pneumabranchnus*, McClelland, Calcutta Journ. Nat. Hist., v, 1844, p. 192 (*striatus* = *cuchia*).

Characters and distribution of the genus included in those of the family. Only one species recognised. (*ἀμφί*, around; *πνοός*, breathing: in reference to the confluent gill-openings).

#### AMPHIPNOUS CUCHIA.

- Muraena pinnis carens*; Dondoo Paum, Russell, Fishes Vizagapatam, i, p. 25, pl. xxxv, 1803; Ankapilly Lake.  
*Unibranchapertura cuchia*, Hamilton-Buchanan, Fishes Ganges, p. 363, pl. xvi, fig. 4, 1822; South-eastern Bengal.  
*Amphipnous cuchia*, Muller, Abhandl. Akad. Berlin, 1839, p. 244—Cantor, Malay. Fishes, p. 338 footnote, 1850; Punjab—Bleeker, Verh. Batav. Gen. xxv, 1853, Bengal en Hindoustan, p. 78—Kaup, Catal. Apod. Fishes, p. 120, 1856—Gunther, B.M. Catal. Fishes, viii, p. 13, 1870; Bengal—Day, Fishes India, p. 656, pl. clxvii, fig. 1, 1878—id., Faun. Brit. India, i, p. 69, 1889, fig. 27.  
*Ophichthys punctatus*, Swainson, Nat. Hist. Classif. Fishes, ii, p. 336, 1839.  
*Pneumabranchnus striatus*, McClelland, Calcutta Journ. Nat. Hist., v, 1844, pp. 195 & 219, pl. xiii.  
*Pneumabranchnus leprosus*, McClelland, ibid., pp. 196 and 219.

Body slender, its depth  $14\frac{2}{3}$  in the space between the extremity of the snout and the vent, and 23 in the total length. Length of head 5 in that of the trunk and  $9\frac{1}{2}$  in the total length. Snout very short and truncate, wider than long, as long as the eye, not projecting beyond the lower jaw. Eye very small, situated in the anterior fifth of the head, oval, its horizontal diameter twice as long as its vertical, the former  $\frac{1}{10}$  of the length of the head and more than the interorbital width. Cleft of mouth wide, its length  $\frac{1}{3}$  of that of the head. Lips fleshy, laterally plicated. Dorsal fold originating rather less than the length of the head in advance of the vertical from the vent. Length of tail  $1\frac{5}{8}$ .

in that of the head and trunk. Uniform brown, the snout, mandible, and branchial region livid gray. (*Cuchia*; the native name of this species among the Bengalese).

Length to 600 millimeters.

Distribution similar to that of the family, of which it is the sole representative.

#### MEASUREMENTS IN MILLIMETERS.

Total length	..	..	..	..	..	..	..	300
Length of head (to gill-opening).				..	..	..	..	31.5
Length of trunk	..	..	..	..	..	..	..	155.5
Length from tip of snout to vent.	..	..	..	..	..	..	..	187
Length of tail	..	..	..	..	..	..	..	103
Depth of body	..	..	..	..	..	..	..	13
Cleft of mouth	..	..	..	..	..	..	..	10.5

This unique Australian example belongs to the collection of the South Australian Museum at Adelaide, and is labelled as having been collected in Edcombe (? Edgecombe) Bay, Queensland. It formed one of a collection of catfishes and eels kindly forwarded to me for examination some years ago by the Trustees of that Museum, to whom I take this opportunity of again returning my grateful thanks.

I have gone very fully into the history of this well known Indian fish for two sufficient reasons;—firstly, because this is the earliest record of its occurrence in Australian waters, and indeed, so far as I am aware, in any waters east of Burmah, no mention being made of it as a Malayan fish by either Cantor or Bleeker. I have, however, no reason to doubt that the locality given above is correct, even though its presence in the intermediate area has escaped the detection of such keen observers as the two biologists referred to as well as of all our Australian collectors; and secondly, because I do not know any detailed diagnosis of the family *Amphipnoidæ*. Though the genus *Amphipnous* has been included in the *Symbranchidæ*, (though separated as a subfamily, *Amphipnoina*) by Günther, Day, and others, the presence of scales and of a lung-like accessory branchial organ, and the degradation of the osseous attachment between the shoulder-girdle

and the skull to a simple cartilaginous rod, fully justify its separation from the other symbranchoid genera, though in the reduction in the number of gill-arches and the rudimentary nature of the gill-fringes it approaches *Monopterus*.

Writing of this fish (Fish. Ind., p. 655) India's celebrated ichthyologist, the late Surgeon-General Day, remarks:—"This amphibious fish, when kept in an aquarium, may be observed to constantly rise to the surface for the purpose of respiring atmospheric air direct. It usually remains with its snout close to the surface, and in like manner lies in the grassy sides of pools and stagnant pieces of water, so that without trouble it may obtain its modicum of air." In fact, the principal accessory breathing organ, which, in the form of a lung-like sac, lies along each side of the throat, and communicates with the gill-cavity, is so beautifully arranged that it performs the principal functions of respiration, being emptied or inflated at the will of the individual. When distended with air these sacs have the appearance of a pair of rounded cushions, one on each side of the throat.

## ORDER APODES.

### MORINGUIDÆ.

#### THE SHORT-TAILED EELS.

Tongue present; gill-openings narrow and inferior; heart far behind the gills; vertical fins confined to the tail, which is very short; pectoral fins small or wanting.

The moringuids form a small and compact group of erechelycephalous eels, having affinities on the one side to the *Ophichthyidæ*, on the other to the *Muraenidæ*. No species has hitherto been recorded from the Australian seas, and the announcement, now made, of the occurrence of an *Aphthalmichthys* on our northern coast is entirely due to the acumen of Mr. George Masters, who first called my attention to the specimen—which is exhibited in the collection of the Macleay Museum, Sydney University—and assured me that to his personal knowledge it came from the "North Coast of Australia, probably Port Darwin." There is nothing remarkable in the presence of a moringuid eel in our waters; indeed, our lack of know-

ledge of the marine fauna of northern and western Australia is probably responsible for the omission of other species belonging to the family, the head-quarters of which are situated in the Malay Archipelago, from whence they have spread northward to Japan\* and westward to the Ganges.

Three genera of of *Moringuidæ* are here recognised, and since all may possibly occur on the Queensland coast, the subjoined analysis, which, taken in conjunction with the short family diagnosis given above, will greatly simplify identification, is arranged :—

a. Dorsal and anal fins with distinct rays.

b. Vertical fins continuous, the anal originating near the vent ; pectoral fins minute or rudimentary .. .. PSEUDOMORINGUA.

bb. Vertical fins interrupted mesially, the anal originating well behind the vent ; pectoral fins present. .. .. MORINGUA

aa. Dorsal and anal fins reduced to a low rayless fold, with a few feeble rays at the extreme tip of the tail only ; pectoral fins absent or vestigial. .. .. APHTHALMICHTHYS.

#### APHTHALMICHTHYS.

*Aphthalmichthys*, Kaup, B. M. Catal. Apod. Fish., p. 105, 1856 (*javanicus*).

Body more or less vermiform and terete. Lateral line continuous, formed by a series of open, mucous pores. Head small or moderate, with narrow, pointed snout. Mouth with narrow, horizontal cleft, extending but little beyond the eye, the lower jaw the longer. Teeth in a single series on the jaws and vomer. Nostrils lateral, the anterior near the extremity of the snout, tubular ; the posterior in front of and near the eye, oval and horizontal. Eyes small, anterior, indistinct. Gill-openings narrow, oblique, inferior. Vertical fins rudimentary, reduced to a low fold of the skin ; a few feeble rays developed round the tip of the tail. Pectoral fins vestigiary or entirely wanting. Vent posterior, remote from the origin of the anal fold. Tail much shorter than the head and trunk (*ἀ*, privative ; *ὀφθαλμός*, eye ; *ἰχθύς*, a fish.)

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\*Jordan and Snyder (Proc. U.S. Nat. Mus., xx, 1901, p. 877) include two species—*Aphthalmichthys abbreviatus* and *A. javanicus*—in their list of Japanese fishes, both of which probably came from the southern Riu-kiu Islands. They also remark of the family—"The genera are closely related and two of them—*Moringua*=*Raitaboura*=*Stilbiscus* and *Aphthalmichthys*—are found in the West Indies as well as in the East."

Malay Archipelago to India and Japan; North Coast of Australia; West Indies (Porto Rico).<sup>8</sup> Species 5.

*Analysis of Austro-Malayan Species.*

- a. Depth of body 75 to 95 in the total length.
  - b. Head 4 times as deep as long.
    - c. Length of head 15 to 22 in the total length; cleft of mouth 5 to  $5\frac{1}{2}$  in the length of the head; no trace of pectoral fins.
      - .. .. 1. *javanicus*.
- aa. Depth of body 40 to 51 in the total length.
  - d. Head less than 4 times as deep as long.
    - e. Length of head  $14\frac{1}{2}$  in the total length; cleft of mouth  $4\frac{1}{2}$  in the length of the head; no trace of pectoral fins.
      - .. .. 2. *intermedius*
    - ee. Length of head 12 in the total length; cleft of mouth  $4\frac{1}{2}$  to  $4\frac{1}{2}$  in the length of the head; pectoral fins visible but very small.
      - .. .. 3. *abbreviatus*.<sup>4</sup>
  - dd. Head more than 4 times as deep as long.
    - f. Length of head 9 in the total length; cleft of mouth 5 in the length of the head; pectoral fins visible but very small.
      - .. .. 4. *macrocephalus*

*APHTHALMICHTHYS INTERMEDIUS, sp. nov.*

Body anguilliform, its depth  $3\frac{1}{2}$  in the length of the head, 36 in the distance between the tip of the snout and the vent, and about 51 in the total length. Length of head from snout to gill-opening a little more than 10 in the trunk and  $14\frac{1}{2}$  in the total length. Diameter of eye  $2\frac{1}{2}$  in the length of the snout. Snout with convex profile, 7 in the length of the head. Cleft of mouth extending somewhat beyond the vertical from the posterior border of the eye, its length from the tip of the snout  $4\frac{1}{2}$  in that of the head. A few of the front teeth on both jaws and vomer enlarged and fang-like. Gill-openings much wider than the eye, the length of the slit  $\frac{1}{3}$  of the isthmus. Length of tail  $2\frac{1}{2}$  in that of the head and trunk. Dorsal and anal fins represented by inconspicuous dermal folds, which originate on the same plane about three fourths of

<sup>8</sup>*Aphthalmichthys caribbeus*, Gill & Smith, Science, (2) xi, 1900, p. 974.

<sup>4</sup>The Japanese fish described as *A. abbreviatus* by Jordan and Snyder (Proc. U.S. Nat. Mus., xxiii, 1901, p. 877), differs from the typical form in its longer and much shallower head, shorter cleft of mouth, better developed fins, etc., and may well be characterized as a new species to which the name *Aphthalmichthys affinis* might suitably be applied.

the length of the head behind the vent, and are confluent around the end of the tail, where alone a few short rays are perceptible. Pectoral fins wholly wanting. (*intermedius* intermediate—between *javanicus* and *abbreviatus*).

*Measurements in millimeters.*

Total length	..	..	..	..	..	..	304
Length of head (to gill-opening)	..	..	..	..	..	..	21
Length of trunk	..	..	..	..	..	..	194
Length from tip of snout to vent	..	..	..	..	..	..	215
Length of tail	..	..	..	..	..	..	85
Depth of body	..	..	..	..	..	..	6
Length of snout	..	..	..	..	..	..	3
Cleft of mouth	..	..	..	..	..	..	5

Type in the University Museum, Sydney.

North Coast of Australia, probably Port Darwin (*vide* Masters.)

MURÆNIDÆ.

THE MORAYS OR MURRIES.

No tongue; gill-openings small, lateral, subcircular; heart not far removed from the gills; no pectoral fins.

These eels are common in Australasian waters, whence 19 species have been recorded. These belong to at least 6 genera, but as many of the available descriptions omit certain characters necessary for generic identification, it is possible that some of the species which I have assigned to *Gymnothorax* should be placed elsewhere. Appended is an analysis of the Australasian genera.

- a. Vertical fins well developed, the dorsal originating in advance of the vent.
- b. Posterior nostril circular.
- c. All the teeth acute.
  - d. Form not excessively elongated, the tail of moderate length.
  - e. Lips continuous with the skin of the head; each anterior nostril with a long tube.
  - f. Posterior nostril without tube, the margin sometimes slightly raised.
    - g. Dorsal fin inserted behind the head, above or behind the gill-openings . . . . . i. *RABULA*.
    - gg. Dorsal fin inserted on the head, considerably in advance of the gill-openings . . . . . ii. *GYMNOTHORAX*.
    - ff. Both pairs of nostrils with a conspicuous tube. . . . . iii. *MURÆNA*.
  - dd. Form greatly elongated, the tail very long . . . iv. *RHABDURA*.

- c. Teeth mostly obtuse and molariform; anterior nostrils tubular; dorsal fin originating in advance of the gill-opening.

..... V. ECHIDNA

- aa. Vetical fins absent or confined to the end of the tail; teeth in several series, rather small, pointed, and subequal.

- b. Cleft of mouth short, not half the length of the head; snout moderate, about half the gape; tail about as long as the trunk

..... VI. UROPTERYGIUS,

The following is a list of the genera and species, with the original references, at present known to inhabit the seas of Australasia:—

- i. RABULA, Jordan & Davis, Rep. U.S. Fish. Comm., viii, 1888, p. 589 (*aquæ-dulcis*).
1. *callorhynchus*, Günther, B. M. Catal. Fish., viii, p. 122, 1870; Fremantle, West Australia.
- ii. GYMNOTHORAX, Bloch, Anl. Fische, ix, p. 85, 1735 (*reticularis*).
2. *richardsonii*, Bleeker, Nat. Tijdschr. Nederl. Ind., iii, 1852, p. 296; Wahai, Ceram & Padang, Sumatra. Houtmans Abrolhos
3. *pictus*, Ahl, in Thunberg's Dissert. de Mur. et Oph., p. 6. pl. ii, fig. 2, 1789; Eastern Australia
4. *flavimarginatus*, Rüppell, Atlas Fische Roth. Meer., p. 119, pl. xxx, fig. 3, 1828; Red Sea; Lord Howe and Norfolk Islands.
5. *tessellatus*, Richardson, Voy. Sulphur, Ichth. p. 109, pl. lv, figg. 5—8 1844. Endeavour River, Queensland.
6. *makassariensis*, Bleeker, Nederl. Tijdschr. Dierk, i, 1863; Celebes; Cape York, Queensland.
7. *nubilus*, Richardson, Zool. Erebus & Terror, Ichth. p. 81, pl. xlvii, figg. 6—10, 1847; Norfolk Island and Houtmans Abrolhos; Lord Howe Island.
8. *thyrsoides*, Richardson, Voy. Sulphur, Ichth. p. 111, 1844; East Coast of Australia; Lord Howe Island.
9. *undulatus*, Lacépède, Hist. Nat. Poiss., v, pp. 629 & 644, 1803; East coast of Australia.
10. *pseudothyrsoides*, Bleeker, Nat. Tijdschr. Nederl. Ind., iii, 1852, p. 778; Macassar, Celebes, Darnley Island.
11. *chalazius*, Waite, Rec. Austr. Mus., v, 1904, p. 145, pl. xvii, fig. 2; Lord Howe Island.
12. *fimbriatus*, Bennett, Proc. Zool. Soc., 1831, p. 168; Mauritius; Port Essington, Northern Territory; Torres Straits.
13. *melanospiilos*, Bleeker, Nat. Tijdschr. Nederl. Ind., ix, 1855, p. 279; Sibogha, Sumatra; Darnley Island.
14. *prionodon*, Ogilby, Proc. Linn. Soc. N. S. Wales, xix, 1865, p. 721, Port Jackson.
- iii. MURÆNA, Artedi; Linnæus, Syst. Nat., p. 243, 1758 (*helena*).
15. *varax*, Ogilby: new name proposed for the Australian form hitherto identified with *M. helena*.
- iv. RHABDURA, Ogilby. (v. infra, p. 12).



16. *macrura*, Bleeker, Nat. Tijdschr. Nederl. Ind., vii, 1854, p. 354 ;  
Anjer, Java ; Moreton Bay.  
v. ECHIDNA, Forster, Enchiridion, p. 31, 1778 (*variegata*).
17. *nebulosa*, Ahl, in Thunberg's Dissert. de Mur. et Oph., p. 5, pl. i, fig. 2,  
1789. Torres Straits ; Lord Howe Island.
18. *polyzon*, Richardson, Voy. Sulphur, Ichth. p. 112, pl. iv, fig. 11—14,  
1874 ; Torres Straits.  
vi. UROPTERYGIUS, Rüppell, Neue Wirbelth. Abyss., Fische Roth.  
Meer., p. 83, 1838 (*concolor*).
19. *concolor*, Ruppell, *ibid.*, pl. xx, fig. 4 ; Cape York, Queensland.

### RHABDURA, *nom. nov.*

*Thyrsoidea*, Bleeker, Atl. Ichth., iv, p. 110, 1864 (*macrurus*). Not Kaup, 1856.

Body exceedingly elongate and slender slightly compressed. Lateral line rather conspicuous, composed of short, separate tubes. Head small, its upper profile feebly convex, with short, pointed snout. Mouth with wide horizontal cleft, extending far beyond the eye, the jaws subequal ; lips smooth. Teeth acute, compressed, well separated, biserial in the jaws, uniserial on the vomer ; all the enlarged anterior teeth depressible. Anterior nostrils tubular, the posterior simple. Eyes small, anterior. Gill-openings situated below the median line of the trunk, large and crescentic.<sup>5</sup> Vertical fins low, the dorsal originating about midway between the gill-opening and the angle of the mouth. Vent close in front of the anal fin. Tail very long, much longer than the head and trunk. (*ῥάβδος*, a rod or wand ; *οὐρά*, tail : in reference to its exceedingly long and slender tail.)

From the Cape of Good Hope to Eastern Australia.

For reasons given below I find myself compelled to propose a new name for the moray to which Bleeker arbitrarily restricted Kaup's genus *Thyrsoidea*.

In my view of the case the type of Kaup's heterogeneous genus is his *Thyrsoidea macrops* (= *Gymnothorax makassariensis*, Bleeker), this being the first species described by that author under his new generic name, and no

<sup>5</sup>I have here described the shape of the gill-openings as figured by Bleeker and Day, to both of whom the species was well-known, and who were unlikely to make a mistake ; in my example, however, they form a straight horizontal slit on each side, resembling the gash of a knife. Possibly this may be an individual peculiarity.

species having been designated specially by him as the type ; in addition to this his *Thyrsoidea longissima* (= *Muraena macrurus*, Bleeker-) belongs to a totally different section of the genus according to the author's own arrangement of the species. Taking these facts into consideration, I cannot see any valid reason for perpetuating Bleeker's arbitrary action in selecting as the type of *Thyrsoidea* a species which, in the opinion of the original founder of the genus himself, was an aberrant or at the least a non-typical form

#### RHABDURA MACRURA.

*Muraena macrurus*, Bleeker, Nat. Tijdschr. Nederl. Ind., vii, 1854, p. 354 ; Anjer, Java—Günther, Catal. Fish., viii, p. 127, 1870 : Port Natal ; Ceylon.

*Thyrsoidea longissima*, Kaup, Catal. Apod. Fish., p. 82, 1856—id., Arch. f. Nat., xxii, 1856, p. 61 ; Sea of Hindoostan.

*Thyrsoidea macrurus*, Bleeker, Atl. Ichth., iv, p. 111. pl. CLXvi, fig 2, 1864—Kner, Voy. Novara. Fische p. 386, 1867.

*Muraena macrura*, Day, Fish. Ind., p. 672, pl. CLxx, fig. 5, 1878—id., Faun. Brit. Ind., i, p. 81, 1889, fig. 32.

B. ix. D. 493 circ.; A. 326 circ.; C. 12 circ = D. + C. + A. 821 circ. (*vide* Bleeker).

Depth of body at the gill-opening  $13\frac{1}{2}$  in the space between the extremity of the snout and the vent and 38 in the total length. Width of body about  $\frac{5}{8}$  of its depth. Length of head from snout to gill-opening 4 in the trunk and 14 in the total length. Diameter of eye  $2\frac{1}{2}$  in the length of the snout, which is  $10\frac{1}{2}$  in that of the head. Jaws not completely closing when the mouth is shut. Cleft of mouth extending about six diameters of the eye behind the eye, its length  $2\frac{3}{8}$  in that of the head. Teeth in the upper jaw in two series, those of the outer series 20 or 21 in number and rather irregular in size, the fourth on each side being much the longest ; inner series consisting of 7 or 8 subequal teeth, which are uniformly longer than those of the outer series and are situated opposite to the vomerine band ; a median series of 4 teeth\*, which increases in size from the front of the premaxillary ; vomer with a single row of about 8 small teeth ; mandibular teeth

\*Perhaps 5, since there is a considerable interval between the third and fourth.

in two series, the outer subequal in size, and 20 or 21 in number, the inner with 6 enlarged teeth, corresponding to the median premaxillary teeth. Width of gill-opening  $3\frac{1}{2}$  times that of the eye. Length of head and trunk  $1\frac{1}{2}$  in that of the tail. Uniform brown, dark above, lighter below, the vertical fins blackish brown (*μακρός* long; *ὀυρά*, tail).

Length to 3,000 millimeters and upwards (Day).

From Natal through the seas of India and the Malay Archipelago to Eastern Queensland.

*Measurements in Millimeters.*

Total length	..	..	..	..	..	..	..	..	2286.
Length of head (to gill-opening)						..	..	..	162.
Length of trunk	..	..	..	..	..	..	..	..	650.
Length from tip of snout to vent	..	..	..	..	..	..	..	..	812.
Length of tail	..	..	..	..	..	..	..	..	1474.
Depth of body (at gill-opening)	..	..	..	..	..	..	..	..	60.
Width of body (at gill-opening)	..	..	..	..	..	..	..	..	51.
Length of snout	..	..	..	..	..	..	..	..	15.
Diameter of eye	..	..	..	..	..	..	..	..	6.5
Cleft of mouth	..	..	..	..	..	..	..	..	61.
Length of gill opening	..	..	..	..	..	..	..	..	21.

This eel, the first <sup>7</sup> recorded from Australian seas, was captured on January 4th, 1904, with hook and line by Mr. James S. Cruse, "in the deep-water bend of the Pine River about four miles from the Bay."<sup>8</sup> He describes it as playing very hard and being very fierce when landed. After getting it out on the bank, he continues—"When I went to him he raised the fin along his back and looked very fierce. I cut the line not caring to touch him, and let him lie; he soon died, not living a long time as eels generally do.

This species attains a length of ten feet and is probably the largest apodal fish in existence. I have not been able to learn anything about its habits, but it is a new experience to me to find one of the murænoid eels, a group usually

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<sup>7</sup>A second and rather larger example was caught in the Brisbane River near Pinkenba in October and came into my hands through the kindness of Mr. V. H. Jeff, of Queen St.

<sup>8</sup>Mr. A. Graham, who kindly forwarded the specimen to the Museum on behalf of Mr. Cruse, gives the locality of the capture as "Greenwood Pocket, Bald Hills."

strictly confined to the purest salt water, so far up a small river and away from its normal surroundings among rocks and reefs.

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## SOME NEW PEDICULATE FISHES.

By J. DOUGLAS OGILBY.

[Read before the Royal Society of Queensland 2nd April, 1906.]

### RHYCHERUS, *gen. nov.*

Form robust; body compressed, elevated in front, rapidly tapering behind. Head large, as deep as long. Skin smooth, densely clothed with cutaneous appendages. Mouth protractile, with moderate subvertical cleft; maxillary thin and flexible, remiform, extending well beyond cleft of mouth. Jaws, vomer, and palatines with small cardiform teeth; tongue smooth. Eyes moderate; infraorbital groove deep and naked. Gill-opening forming a simple longitudinal slit on the lower edge of the pseudobranchium some distance in advance of the fin. All the fins with numerous appendages: dorsal spines well developed, erect, mobile, free; rostral spine slender, rising directly from the tip of the snout, and terminating in a bifid tentacle; frontal and occipital spines stouter than but as flexible as the rostral, widely separated, with a deep naked fossa intervening, the latter inserted far behind the eye; second dorsal with 13 rays, most of which terminate in a long filament: anal fin with 8 simple rays, inserted below the terminal third of and far overlapping the soft dorsal: caudal fin rounded, with 9 rays, all except the outer pair branched; caudal peduncle free: pseudobranchium immobile, firmly fixed to the side by the enveloping cuticle, pectoral fin large and rounded, with 10 simple rays, extending, when appressed, to the origin of the anal: ventrals small and rounded, with 5 simple rays. (*ῥυχῆρός*, ragged: in allusion to its shaggy appearance due to the crowded cutaneous appendages).

Southern Shores of Australia (Victoria and South Australia). Two species. This genus forms a connecting

link between *Antennarius* and *Pterophrynoides*, agreeing with the former in the robust form, the completely isolated rostral spine, the fixed pseudobrachium, and the small ventrals; with the latter principally in the smooth skin, (See p. 24 *infra* for key).

*RHYCHERUS WILDII*, *sp. nov.*

D. iii, 13 : A. 8 : C. 9 : P. 10 : V. 5. Cutaneous appendages simple or ramose, longest on the head. Depth of body  $\frac{5}{8}$  of the total length. Upper profile from tip of snout to origin of soft dorsal undulating, the concavity between the frontal and occipital spines, wide and deep. Length of head  $1\frac{1}{2}$ , its width  $2\frac{3}{8}$  in the total length. Mental tubercle small; length of maxillary about  $\frac{1}{2}$  of that of the head, its distal extremity rounded and as wide as the eye. Snout  $6\frac{1}{2}$  in the length of the head,  $3\frac{1}{2}$  in that of the maxillary, and equal to the eye and the interorbital width. Rostral spine terminating in a pair of widely separated fleshy lobes, forming together a crescentic appendage, behind which is a low broad petiolate flap, bearing on each side a criniform filament; height of spine  $\frac{3}{8}$  of the length of the head; it extends, when depressed, beyond the naked interspinous fossa; second spine  $\frac{1}{4}$  longer than the first, fringed, bearing near its extremity a pair of lateral ramose filaments, and reaching back to the base of the occipital spine, which is similar, but shorter, and bears in addition a pair of median filaments, which are ciliated distally and more than half the length of the spine; height of spine  $2\frac{2}{3}$  in the head, its tip somewhat dilated and papillose, reaching, when depressed, to the origin of the second dorsal. Length of second dorsal rather more than its distance from the tip of the snout and rather less than the head; first ray slightly produced; second and third normal; middle rays (and probably the posterior) terminating in a long filament, the fifth\* about  $\frac{3}{4}$  of the length of the fin; the rays, when depressed, reach far beyond the base of the caudal. Anal fin originating below the 9th dorsal ray, rounded, the middle ray the highest,  $1\frac{1}{2}$  time the basal length,  $\frac{2}{3}$  of the highest dorsal ray, and reaching a little beyond the base of the caudal;

\* Our specimen is in bad condition, and most of the radial filaments are broken.

its length is  $2\frac{3}{5}$  in that of the head, its distance from the tip of the closed mandible  $\frac{2}{3}$  of the total length; last dorsal and anal rays without membrane, leaving a clear space between them and the caudal fin. Length of caudal fin  $3\frac{2}{5}$  of space between its base and the last dorsal ray  $9\frac{3}{4}$ , least depth of caudal peduncle  $7\frac{1}{4}$  in the total length. Free portion of pseudobranchium and pectoral fin  $3\frac{1}{8}$  in the total length. Ventral fin  $2\frac{1}{2}$  in the head. Uniform brown.†  
(Named for Charles James Wild, Acting Curator of the Queensland Museum, by whose courtesy I am permitted to make the above description.)

Type in the Queensland Museum, Brisbane

Length to tip of middle caudal ray, 77 millimeters.

Distribution :—Southern Australia.

This species differs considerably from *Chironectes bifurcatus*, McCoy,§ with which, however, it is undoubtedly congeneric.

#### TATHICARPUS, *gen. nov.*

Form more or less robust; body compressed, elevated in front, rapidly tapering posteriorly. Head large, longer than deep. Skin dotted with small tubercles, separated from each other by a naked interspace, and each bearing a bifid spinule. Head and body with cutaneous appendages in varying number. Mouth protractile, with moderate, subvertical cleft; maxillary thin, flexible, remiform, with a strong median longitudinal ridge, extending far beyond cleft of mouth. Jaws, vomer, and palatines with strong unequal, cardiform teeth; tongue smooth. Eyes moderate, with well developed supraciliary ridge; infraorbital groove deep, naked. Gill-opening a rather large oval orifice, pierced at the end of a prominent papilla, and situated below and behind the inferior axil of the pseudobranchium. Fins spinulose with or without cutaneous appendages: dorsal spine erect, mobile, the two last membraniferous; rostral spine slender, long, inserted upon a small bony tubercle above

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† After a long immersion in alcohol. This cannot be taken as any indication of its true coloration.

§ Prodr. Zool. Vic., ii, p. 87, dec. xiii, 1886, pl. 123.



the tip of the snout and terminating in a simple tentacle ; frontal and occipital spines shorter and stouter than the rostral, latter inserted immediately behind eye, widely separated, without intervening naked fossa ; all the fin-rays simple ; second dorsal high, with 11 slender rays, connected by delicate, diaphanous membrane, and deeply cleft at the extremity : anal fin with 7 rays, similar to second dorsal, and inserted entirely or almost entirely behind it : caudal fin long and rounded, with 9 rays ; caudal peduncle free : pseudobrachium almost wholly free and mobile ; pectoral fin long and narrow, with 7 rays : ventrals moderate, pointed, with 5 rays, inserted behind the occipital spine. (*ραθείς*, extending ; *καρπός*, wrist : in reference to the greatly elongated actinosts).

East Coast of Queensland (Port Curtis). Two species. In the length and mobility of the pseudobrachium this genus is only approached by *Brachionichthys*, from which, however, the position of the gill-openings widely separates it.

#### *Key to the Species.*

- Head and body with a few small scattered filaments ; pectoral fin reaching to the base of the caudal .. .. . *butleri*.  
 Head and body with numerous long ramulose filaments ; pectoral fin reaching to the end of the base of the anal. .. .. . *muscosus*.

D. i,i,i, 11 : A. 7 : C. 9 : P. 7 ; V. 5. Cutaneous appendages in small number, simple, longest on the chin, throat, and corner of the mouth. Depth of body  $1\frac{2}{3}$  in the total length. Upper profile from tip of snout to base of occipital spine gently, thence to origin of second dorsal strongly convex. Length of head  $1\frac{3}{4}$ , its width  $3\frac{3}{4}$  in the total length. Mental tubercle small ; maxillary extending to below the posterior border of the orbit, its length  $2\frac{1}{4}$  in that of the head, its distal extremity rounded, and about half as wide as the eye. Snout 6 in the length of the head,  $3\frac{3}{4}$  in that of the maxillary,  $1\frac{1}{2}$  in the diameter of the eye, and equal to the interorbital width. Rostral spine  $\frac{5}{8}$  of the head, extending, when depressed, midway along the interdorsal space ; frontal spine  $\frac{1}{2}$  of the rostral, curved, extending, as also does its membrane, to the base of the occipital spine ; occipital spine similar to but much longer than the frontal, bearing anteriorly a long median and sub-

terminal filament, its height  $2\frac{1}{2}$  in the head, and reaching backwards beyond the origin of the second dorsal, to the base of which it is attached by membrane. Length of second dorsal rather less than its distance from the tip of the snout and  $1\frac{1}{2}$  in the length of the head; rays subequal, the third the highest,  $\frac{3}{4}$  of the basal length; depressed rays reaching slightly beyond the base of the caudal. Anal fin originating behind the second dorsal, acutely pointed, the middle ray the highest,  $2\frac{1}{2}$  in the basal length, a little higher than the highest dorsal ray, and extending far beyond the base of the caudal; its length is rather more than  $\frac{1}{4}$  that of the head; its distance from the tip of the closed mandible  $\frac{1}{5}$  of the total length: last dorsal and anal rays without membrane, leaving a clear space between them and the caudal. Length of caudal fin  $2\frac{1}{2}$ , of space between its base and the last dorsal ray  $5\frac{1}{2}$ , least depth of caudal peduncle  $6\frac{1}{4}$  in the total length. Pectoral fin extending, when depressed, to the root of the caudal; its length with that of the free pseudobranchium about half the total length. Second ventral ray the longest,  $\frac{1}{3}$  of the head. Roseate; inter- and post-orbital regions, deep violet gray studded with blackish spots and bars; the whole of the eye, except the pupil, which is yellow, suffused with a lighter tint of the same; a broad band across the preorbital and the inner edge of the maxillary violaceous gray; entire postmental, thoracic, and subopercular regions suffused with lilac; tip of chin violet; a round violaceous spot on the side of the head below the post-orbital blotch; a broad irregular violaceous band, with deeply embayed edges, and containing blotches and spots of deep black, from below the eight anterior rays of the second dorsal to the inner angle of the pseudobranchium; a large rounded spot of the same color below the middle of the appressed limb; a second band nearly covering the caudal peduncle; all the filaments, wherever situated, deep black. Rostral spine with alternate rings of violet and white, the tentacle blackish; membrane of frontal spine purple; basal half of occipital spine roseate, the rest purple; its entire membrane, except the outer angle, rosy; rays of soft dorsal blackish, the connecting membrane hyaline, more or less

clouded with violet ; anal fin similar to the soft dorsal, but crossed by four dark bars, the basal one continuous, the others interrupted ; caudal rays with black and yellow rings, the membrane uniformly hyaline ; posterior half of the outer edge of the pseudobranchium and the pectoral rays blackish ; ventral rays similar with lighter tips. (Named for Dr. A. Graham Butler, its discoverer).

Type in the Queensland Museum, Brisbane

Length to tip of middle caudal ray 93 millimeters.

Distribution : Port Curtis, Queensland.

Writing of this species Dr. Graham Butler informs me :—"The specimen in question was caught by the local fishermen while netting among coral and seaweed for Trumpeter at 'North End', port Curtis Harbour. They had not seen one like it before, so it is evidently uncommon here. . . . . The color was a brilliant orange." Within the few days which elapsed between its capture and my receipt of it, the brilliant orange had faded to a dead white, with here and there a roseate tinge.

The most noticeable character in this fish is of course the enormous elongation of the carpal bones, which gives to the pectoral limb very much the appearance of the fore-leg of a frog, and like it is capable of moving easily upwards or downwards, but can only move forwards to a right angle with the body from the joint which unites it to the pectoral arch, the want of elasticity in the axillary membrane not permitting of a further movement in that direction. The second joint, however, allows of the pectoral rays being laid directly forwards alongside of the proximal actinosts. The fin itself is narrow, and resembles more the claws of a bird than the rays of a fish.

*TATHICARPUS MUSCOSUS, sp. nov.*

Head and body, except the abdominal region, with numerous long ramulose cutaneous appendages. Depth of body  $1\frac{1}{2}$ , length of head  $1\frac{1}{2}$ , width of head  $2\frac{2}{7}$  in the total length. Length of maxillary  $2\frac{2}{3}$  in that of the head. Snout  $5\frac{1}{4}$  in the head,  $2\frac{1}{3}$  in the

maxillary, equal to the diameter of the eye, and about  $\frac{1}{2}$  more than the interorbital width. Rostral spine  $2\frac{2}{3}$  in the length of the head, extending, when depressed, slightly beyond the occipital spine; frontal spine about  $\frac{2}{3}$  of the rostral, its membrane not extending to the succeeding spine, which, like it, terminates in long ramulose filaments; occipital spine similar to the frontal and as high as the rostral, its membrane extending about midway to the second dorsal. Length of second dorsal about  $\frac{4}{5}$  of that of the head; fourth ray the highest,  $\frac{2}{3}$  of the basal length; the depressed rays do not reach the base of the caudal. Anal fin originating below the penultimate dorsal ray, its middle ray about half the basal length. Length of caudal fin  $2\frac{1}{2}$ , of space between its base and the last dorsal ray  $5\frac{1}{2}$ , least depth of peduncle 7 in the total length. Pectoral fin extending, when appressed, to above the end of the anal, its length with that of the free pseudobranchium rather less than half of the total length. Second ventral ray  $3\frac{1}{2}$  in the head. Other characters as in *T. bulleri*. Pale brown, with indistinct greenish spots and ocelli, the abdominal region with a yellow tinge. Rostral spine with alternate rings of gray and brown, the terminal tentacle darker brown; frontal and occipital spines pale brown, the membranes hyaline with greenish ocelli; rays and membrane of second dorsal with scattered dark green spots and dots; anterior portion of anal fin purple, the posterior rays purple-spotted, the entire fin with three light, dark-edged cross-bands; caudal rays with regular series of dark spots: pectoral limbs and fins and ventrals brown, more or less blotched and spotted with green. (*muscosus*, mossy: in allusion to the long ramulose filaments, with which the head, body, and fins are adorned).

Type in the Queensland Museum, Brisbane.

Length to tip of middle caudal rays 98 millimeters.

Distribution:—Port Curtis, Queensland

Appended is a key to the genera of the Australasian antennariids:—

- a.* ANTENNARIIDÆ. Skin naked and smooth or tubercular and spinulose; cleft of mouth vertical or sub-vertical, the lower jaw projecting; gills  $2\frac{1}{2}$  or  $\frac{1}{2}$   $2\frac{1}{2}$ ;

no pseudobranchiæ; pseudobrachium well developed, strongly geniculated, with three actinosts; ventral fins present.

b. Head more or less compressed; anterior dorsal fin with three spines.

c. Body robust and ovate; palatine teeth present; gill-opening in or behind lower axil of pseudobrachium; five ventral rays; stomach dilatable; an air-bladder (*Antennariinæ*).

d. Gill-openings pore-like; anal fin opposite to soft dorsal; pseudobrachium not produced as a mobile limb; pectoral rays at least nine.

e. Two anterior spines of first dorsal united by membrane, the third isolated; ventral fins small .. .. SACCARIUS.

ee. All three spines of first dorsal isolated.

f. Skin granular and spinulose; ventral fins small .. .. ANTENNARIUS.

ff. Skin smooth, without spinuliferous granules.

g. Soft dorsal and anal fins short; pectoral undivided.

h. Rostral spine long, inserted on tip of snout; occipital spine free; pseudobrachium immobile; ventral fins small .. RHYCHERUS.

hh. Rostral spine short, inserted on base of frontal spine; occipital spine membraniferous; pseudobrachium mobile; ventral fins large PTEROPHRYNOIDES.

gg. Soft dorsal and anal fins long; pectorals divided; ventrals small .. .. TETRABRACHIUM.

dd. Gill-openings enlarged and tubular; anal fin behind soft dorsal; pseudobrachium produced as a free mobile limb; ventral fins moderate .. .. TATHICARPUS.

cc. Body slender and elliptical; no palatine teeth; gill-opening above and behind upper axil of

pseudobrachium; four ventral rays; stomach not dilatible; no air bladder. (*Brachichthyinae*).

- i. Gill-openings small and tubular; two posterior spines of first dorsal united by membrane; pseudobrachium produced as a free mobile limb; pectoral rays seven.

.. .. BRACHIONICHTHYS.

The subgeneric name *Diceratias*, given by Günther\* to *Ceratias bispinosus* from the Molucca seas, being untenable owing to the previous use of *Diceratia* by Oken in 1815 for a genus of mollusks, I propose to substitute *Æschynichthys*.†

\*Zool., Challenger, xxii., p. 52, 1887.

†*αἰσχυνή*, shame or disgrace; *ἰχθῦς*, a fish; hence a degraded form of fish.



## NOTES ON EXHIBITS.

By J. DOUGLAS OGILBY.

[Read before the Royal Society of Queensland, 5th March, 1906.]

MR. PRESIDENT, LADIES, AND GENTLEMEN,—

I have the honor to place before your Society to-night the following exhibits of more or less general interest. In the first place I would call your attention to two specimens (Exhibits A. 1 and 2) of an extraordinary egg-case formed by a scyllioid shark, *Chiloscyllium punctatum*. This case is unique among all other known forms in the means employed to attach it after deposition to some foreign substance, such as a projecting point of coral or the root of a mangrove, and so insure the safety of the young fish from stress of weather during its helpless fetal state. In this egg-case you will readily see that, in place of the long tendriform tentacle arising from each corner of the "mermaid's purse," so familiar to all who know the shores of the British Isles, we have a cunningly fashioned handle attached to one of the longer sides of the case, thus forming a perfectly appointed "mermaid's bag," as shown in exhibit A. 1., while A. 2 is the case from which the fetal shark (Exhibit B) was taken. This discovery, for which we are indebted to the patient research of Mr. John T. Jamison of Woody Point, is the more interesting because it proves the oviparity of the typical hemiscylliine sharks, and necessitates a rearrangement of the scyllioid families, and incidentally confirms my long-expressed opinion of the generic validity of *Hemiscyllium modestum*, which I have placed with the "wobbegongs" (*Orectolobidae*) under the new generic title *Brachaelurus*. My views on the subject will be fully set forth in a paper now in preparation, which I hope soon to lay before the Society.



My next exhibits consist of specimens of small fresh-water fishes belonging to the family *Gobiidae*, subfamily *Eleotrinæ*. These are chiefly remarkable in having been participators in the recent aerial escapade reported in the "Telegraph," where it was stated that during a heavy thunder-storm they came down alive in large numbers on Mildura Farm, Cooper's Plain's, last Monday; these specimens were in excellent condition, one in fact having survived its perilous journey through the air, and even more perilous journey corked up in a small medicine bottle for twelve hours in its captor's pocket. I may here state that though I have frequently read of these "showers of fishes," this is only the second authentic instance which has come directly under my notice, the earlier of these being a couple of specimens in poor condition sent from Killarney to the State Museum by our late Premier, the Hon. Arthur Morgan. These belonged to quite a different species from the Cooper's Plains' fishes, being examples of the pretty little Carp-Gudgeon (*Carassioops compressus*, Ogilby), so common in all the creeks and water holes in the vicinity of Brisbane. And here I should like to direct your attention to the two very dissimilar forms of this fish which exist in Southern Queensland. The typical form, originally described by Krefft, from the Clarence River, is a short, stout fish, living in sluggish, muddy creeks and swamps, and said to bury itself in the mud when pursued, as it habitually does during the winter months; the second form is long, slender, and half-starved in appearance, so that, if it were not for the absolute similarity of such structural characters as the fin-formula and lepidosis as well as of the pattern of coloration, it might easily be taken for quite a distinct species; it may conveniently be separated as *C. c. montanus*. To this latter form (exhibit D) the Killarney examples belong, and, as I am informed by my friend Mr. Joseph Lamb, this variety is only found in the head waters of the Condamine, while in the low-lying lands, near the coast only the robust form occurs. Difference of food and environment alone can account for this dissimilarity.

The species, which forms the text of the present communication, belongs to another section of the same group

to which the fishes just referred to belong, and has a remarkable, if not a romantic history. Nearly eight years ago Mr. Alfred Gale, the well known apiarist, informed me that he had seen a number of fishes in a small stone tank, filled with various aquatic plants, in the Botanic Gardens, Sydney. With the permission of Mr. Maiden, we obtained some specimens, which to our astonishment proved to be a perfectly new eleotrin belonging to the *Carassiops* group, but differing generically in the larger number of dorsal spines and the greatly increased number of vertebrae. On these characters with many others of purely specific value, I named the species *Austrogobio galii*. (Exhibit E). I have since found that it is a common Southern Queensland species known to boys as the "Fire-tail," and probable found its way into the Sydney tank by means of ova attached to the leaves of water plants.

Several theories have been propounded to account for the fall of various fishes during heavy rain-storms, the most generally accepted being that the phenomenon is due to a waterspout, but I think that the considerations here put forward will show that such a contention is untenable; in all authenticated cases the fishes, when examined by an expert—a very necessary proviso\*—were found to belong to species wholly confined to a fresh-water existence, and it is a matter of common knowledge that we have nowhere in Queensland so large a body of fresh water as to be capable of giving birth to a water spout of such dimensions as to draw up with it hundreds of fishes; besides, a waterspout would not dissolve in rain but would come down *en masse*, to the destruction of the district on which it fell; also in both the cases of which I have cognizance the species affected were bottom-feeding fishes which would hardly come under the influence of a waterspout as would such high-swimming fishes as the fry of mullet or bony bream. It seems to me that a much more feasible method of accounting for the phenomenon is to be found in the accompanying explanation, which is, I believe, here suggested for the first time: Given that the cyclonic wind that usually precedes and, at least during its earlier stages, accompanies

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\* The Cooper's Plains' fishes were supposed to be young whiting (*Sillago*).

a thunder storm in these latitudes, enters the foot of a gully down which a small creek flows, and gathering strength both from its confined position and on account of the enormous pressure both behind and above it, compelled to take the only available direction—forward—it would, as the gully grew narrower towards its upper end, be forced more and more down to the surface of the ground, with the effect that all movable objects thereon would be carried along, and on reaching the head and meeting a contrary current of air would be whirled up to the skies to come down again perhaps many miles from their point of departure; a small stream of water flowing in an opposite direction to such a storm would be easily sucked up with all it contained. For the sake of comparison I exhibit a fine specimen of the "Crimson-spotted Trout-Gudgeon" (*Krefftius adspersus*, Ogilby), which is also abundant in the creeks round Brisbane (Exhibit F). If this beautiful species be kept in an aquarium, it should, when full grown, be associated only with fishes as large or larger than itself, as it has cannibalistic propensities, which lead it to devour its own and other fry, while specimens of two inches and even more are not immune, as it will attack them and gnaw off their fins.

My last exhibit (G) is a remarkable bone from the head of a selerode matous fish (either *Balistes* or *Monacanthus*), which appears to be an excrescence resultant on an injury, as it is not equally developed on both sides. The curious trigger-like apparatus by which these fishes are enabled to lock the first dorsal spine in an erect position for defensive purposes, is well shown in this exhibit, which has been lent to me by Mr. Squires.

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# A NEW TREE FROG FROM BRISBANE.

By J. DOUGLAS OGILBY.

[Read before the Royal Society of Queensland, 2nd April, 1906.]

## HYLA LUTEIVENTRIS, *sp. nov.*

Tongue subcircular, moderately notched and free behind. Vomerine teeth in two very small groups, in the middle between the choanæ. Head moderate, a little wider than long; snout subtriangular, rounded in front, much longer than the diameter of the eye, which equals its distance from the nostril; canthus rostralis obtusely angular, loreal region oblique, conspicuously concave close behind the nostril. Interorbital region flat, its width equal to  $2\frac{1}{2}$  diameters of the eye; tympanum distinct,  $\frac{3}{4}$  of the diameter of the eye. Three outer fingers extensively webbed, the membrane reaching the disks of the second and fourth; no distinct rudiment of pollex; toes nearly entirely webbed; disks rather more than half the diameter of the eye; subarticular tubercles moderate. Tibio-tarsal articulation reaching beyond the tip of the snout. Exposed upper surface of head and body finely, belly and hinder surface of thighs coarsely granulated. Upper surface of head, body, forearm, tibia, and tarsus, green, the head darkest; a greenish yellow band from the nostril to the tympanum, passing below the eye, where it is widest; a similar spot on the occiput; an indistinct streak of the same color along the canthus rostralis and above the tympanum; upper surface of thighs vinous; entire under surface and rest of the limb orange. Male in breeding season with the outer edge of the first finger rough and brown, strongly contrasting with the rest of the hand. (*luteus*, orange-colored; *venter*, belly).

*Measurements in millimeters.*

Length from snout to vent	..	..	44
Length of head	..	..	14.5
Width of head	..	..	16
Length of snout	..	..	6.5
Diameter of eye	..	..	4
Width of interorbital region	..	..	10
Length of fore limb	..	..	25
Length of hind limb	..	..	67

Type in the Museum of the Amateur Fishermen's Association of Queensland.

Brisbane ; picked up in Wickham Street by the author.

Belongs to the *gracilentia-chloris* group, Though I have followed Boulenger's example, as typified in his *Hyla chloris*, in describing this form as a species, I consider that all the requirements of the case would be amply met if the three were looked upon as varieties of a single species. Their close relationship may be seen at once by a reference to the following key :—

Snout shorter than diameter of orbit ; tympanum distinct ; tibio-tarsal articulation reaching to tip of snout ; upper arm and throat yellow ; belly white.

.. .. 1. (*gracilentia*) *chloris*.

Snout as long as diameter of orbit ; tympanum rather indistinct ; tibio-tarsal articulation reaching to between eye and tip of snout ; lower surface immaculate white.

.. .. 2. *gracilentia* (*typica*).

Snout much longer than diameter of orbit ; tympanum distinct ; tibio-tarsal articulation reaching well beyond tip of snout ; entire lower surfaces orange.

.. .. 3. (*gracilentia*) *luteiventris*.

While lately preparing a rough list of the Queensland batrachians I discovered that two of the genera involved were masquerading under names to which they had no legal title. These are *Chiroleptes* and *Cryptotis*, both of Dr. Günther. The former is preoccupied in *Hemiptera* by Kirby, 1831, and should be replaced by *Phractops*, Peters ; while the latter is similarly rendered unavailable through its use in *Crustacea* by Dana, 1852. I, therefore, propose as a substitute *Adelotus*.

## NOTES ON LEPIDOPTERA.

FROM THE VICINITY OF BRISBANE, THE LARVÆ OF WHICH  
FEED ON LORANTHUS.

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By R. ILLIDGE.

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*Read before the Royal Society of Queensland, 5th March, 1906.*

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THE fleshy foliage of the Mistletoe is subject to the attacks of a large number of lepidopterous insects, a great many being wholly attached to it; to the latter we confine our attention, commencing with the Rhopalocera, or true butterflies.

*Delias* (Pieridæ).—This genus is represented by four species, viz.—*Argenthona*, *Aganippe*, *Nigrina*, and *Harpalyce*. *Argenthona* and *Nigrina* are common, the latter especially so. *Aganippe* is rare about Brisbane, and *Harpalyce* I have never taken, but know of instances of its capture by others; it is the common species in Southern N.S. Wales and Victoria, and is said (McCoy) to spin a curious tough silken web, on which all the larvæ pupate gregariously. The pupa of *Nigrina* is strongly bifid in front. In these four species the upper surface of the imago is rather plain, the under possessing all the gay colour. There are several broods of *Nigrina* and *Argenthona* during the year, and a winter form of the latter having much more black than in the summer, and the basal yellow strongly irrorated with black scales. *Aganippe* and *Argenthona* are sometimes greatly affected by parasitic insects, and probably the extreme rarity of the first-named is so caused. Of *Argenthona* we lately bred out a batch of 18 totally unaffected, but of the next brood of about the same number all were affected, but

two. The third batch of about 15 closely following those parasitised, developed a fungoid disease, and were all lost, some not even having the power to pupate\*

*Nacaduba* (*Lycænidæ*) is represented by the very rare little butterfly *N. palmyra*, Feld.; but few specimens of which are to be found in Australian Cabinets, probably from want of knowledge of its habits.

*Pseudodipsas* (*Lycændæ*).—Of this genus we find two representatives, *P. digglesi* and *P. brisbanensis*, both rare, the latter extremely so.

*Ogyris* (*Lycænidæ*).—The members of this genus hitherto only known from Australia (a species has since been found in New Guinea) are undoubtedly all attached to the mistletoe (*Loranthus*), the larvæ being nocturnal, hiding in crevices during the day. In brilliancy they are probably only equalled amongst Australian butterflies by one or two species of *Miletus*. They are rapid flying insects, and usually very shy and wary, keeping near the tops of trees.

#### *Heterocera.*

*Antheræa*.—Of this genus our mistletoe species *Antheræa loranthi* is certainly the finest of the known Australian forms. We took its caterpillars many years ago in great number from a loranthus, on a high gum tree; attention being drawn to the insects through a storm having blown some down; an examination upward discovered the depleted foliage of the mistletoe, and a stiff climb resulted in our obtaining both larvæ and cocoons. It has the habit of spinning its cocoons of strong brown silk in a large mass, not singly, as our other species do.

*Teara Edwardsi* is a species the larva of which should be handled with great care, as it sheds its hairs when touched, and these cause extreme irritation to the skin. The larvæ are strongly gregarious, and sometimes congregate under a shelter of loose silken web, which if you happen to get under and shake, loose hairs fall and cause exceeding discomfort—chillies rubbed on the skin will,

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\*Of the chrysalides that were formed, a couple were exhibited, in which the fungus could be distinctly seen in the abdominal segments.

perhaps, give some idea. It is the most destructive of all the insects attacking *Loranthus*, occasionally completely denuding it of foliage and even killing the plant. The moth is rarely seen.

*Agarista contorta* is, next to *Agarista agricola*, perhaps the finest of the genus, which is largely represented in Australia. They are day-flying moths, the present species being velvety black with zig-zag yellow markings, and a red-tipped body. It is seldom seen, for it frequents the tops of the *Casuarina* trees. The larva is a very handsome one, and is coloured somewhat like the imago, velvet-black banded with yellow and orange red.

*Ophiusa tirrhaca* and *Ophiusa parcemacula* are two pretty noctuid moths, ochreous or greenish-yellow, with black markings. They are amongst those that perforate and suck the juices of fruits.

*Xylorycta heliomacula* is the imago of a larva that bores the stems of the mistletoe, and is richly adorned in shining fuscous purple and bright ochreous yellow.

<i>Delias argenthona</i>	<i>Teara Edwardsi</i>
„ <i>nigrina</i>	<i>Agarista contorta</i>
„ <i>aganippe</i>	<i>Antheraea loranthi</i>
„ <i>harpalyce</i>	<i>Ophiusa tyrrhaca</i>
<i>Nacaduba palmyra</i>	„ <i>parcemacula</i>
<i>Pseudodipsas Digglesi</i>	<i>Xylorycta heliomacula</i>
„ <i>Brisbanensis</i>	
<i>Ogyris amaryllis</i>	
„ <i>genoveva</i>	
„ <i>abrota</i>	

#### NOTE ON THE DISSEMINATION OF THE MISTLE-TOE BY BIRDS.

The most active agents in the dissemination of the mistletoe are birds, chief amongst which is undoubtedly the Swallow *Dicaeum* (*Dicaeum hirundinaceum*). The steely blue and vivid crimson plumage of the male of this makes it a most conspicuous object amongst the mistletoes in flower and fruit. It swallows the berries whole, and the undigested seeds pass through still covered with much of the viscid matter characteristic of the fruit of this plant.



When dropped on the branch of a tree they adhere by reason of the glutinous substance noted, and winds and rain fail to dislodge them. Germination soon takes place for the passage through the bird's body seems to specially fit them for that purpose, and if the tree prove a suitable host they thrive, otherwise the young plant dies off before attaining any size.

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# ON A NEW TERAPON FROM THE STANTHORPE DISTRICT, SOUTHERN QUEENSLAND.

By J. DOUGLAS OGILBY.

*Read before the Royal Society of Queensland, 31st. August, 1906.*

TERAPON IDONEUS, *sp. nov.*

WHITE'S PERCH.

D. xii 10 ; A. iii 8 ; Sc. 8-54-22 ; L.l. 46.

DEPTH of body equal to length of head,  $3\frac{1}{2}$  in the total length. Dorsal profile much more strongly arched than the abdominal. Upper profile of head obliquely linear, the snout somewhat pointed. Diameter of eye  $5\frac{1}{2}$  in the length of the head and  $1\frac{1}{2}$  in that of the snout. Interorbital region flat, its width  $3\frac{3}{8}$  in the length of the head. Jaws equal. Maxillary extending to the vertical from the middle of the eye, its length  $2\frac{3}{8}$  in that of the head, the width of its distal extremity  $\frac{1}{2}$  of the diameter of the eye. No vomerine or palatine teeth. Preorbital indistinctly roughened posteriorly. Preopercle very finely serrated on and above the rounded angle, smooth below, with 9 or 10 series of small scales ; interopercle with 3 series. Opercle with a pair of strong bony prominences, which hardly constitute true spines, the lower much the larger. Free edge of the coracoid bone finely and evenly denticulated. Gill-rakers, 4 + 11, mostly tubercular, the longest but  $\frac{2}{3}$  of the diameter of the eye. Dorsal fin low, originating well behind the base of the pectorals, the spines increasing in height to the 5th. and 6th., which are  $2\frac{3}{8}$  in the length of the head and about equal to the longest soft ray ; first spine about half the length of the last, which is shorter than the penultimate and half

the height of the soft fin. Anal fin as long as its distance from the caudal; the 2nd. spine much stronger and a trifle longer than the 3rd., 4 in the length of the head. Outer borders of soft dorsal and anal fins convex. Caudal fin subtruncate or very feebly emarginate with the angles rounded, the outer rays  $5\frac{1}{2}$  in the total length; caudal peduncle rather slender, its least depth  $1\frac{1}{2}$  in its length behind the dorsal fin and  $2\frac{3}{4}$  in the depth of the body. Pectoral fin rounded, with 15 rays,  $7\frac{1}{2}$  in the total length. Ventral fins somewhat pointed, originating well behind and rather longer than the pectorals,  $1\frac{3}{4}$  in the head, and not nearly reaching to the vent. Back blackish, washed with deep purple; sides grayish, each scale with a dusky border; under side of head, throat, and abdomen silvery white, slightly tinged with yellow. Dorsal, caudal, and pectoral fins with a greenish yellow wash; anal pale bluish, edged with white; ventrals white, tipped with yellow (*idoneus*, serviceable, suitable; that is, as food).

Length of type from tip of snout to end of middle caudal ray 238 millimeters.

Type in the Queensland Museum, Brisbane.

Upper Condamine River, Southern Queensland.

The type specimen of this handsome *Terapon* was brought to the Museum by Mr. D. O'Connor, who had received it from a correspondent at Stanthorpe. The example was almost immediately placed in my hands by Mr. de Vis for report thereon, with the result that I am, though reluctantly, constrained to consider it an undescribed species. I say "reluctantly" advisedly, because it seems to me that there are already an undue number of local species belonging to this genus described from the fresh waters of Queensland; nevertheless, as this fish differs considerably from all the forms hitherto recorded, I have no option but to give it a provisional name.

The nearest allies then of this new species are *Terapon truttaceus*<sup>1</sup>, Macleay, from the Endeavour River and

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(<sup>1</sup>) *Terapon truttaceus*, Macleay, Proc. Linn. Soc. N. S. Wales, v, 1881, p. 366; Endeavour River, Queensland.

*T. longulus*<sup>2</sup>, Macleay, from "Fresh waters inland from Port Darwin." From the former it differs in the more slender body, the narrower interorbital space, the much larger mouth, the two opercular spines, the finely and evenly denticulated coracoid, the strength of the second anal spine, and the greenish yellow coloration of some of the fins. From the latter it differs in the more robust body and larger head, the wider interorbital space and longer and sharper snout, the feebler denticulation of the preopercle and the coracoid, the shape of the spinous dorsal, the strength of the second anal spine, and the coloration. The species also bears some resemblance to *T. elphinstoniensis*<sup>3</sup>, de Vis, a lacustrine form from Lake Elphinstone<sup>4</sup>, from which it differs in the rather larger scales, deeper body, larger head, nearly smooth preorbital, much wider gape, double-spined operculum, and finely denticulated coracoid.

Personally I was much pleased to obtain this specimen, since it has been the means of clearing up in part the mystery hanging round a fish of which I had previously received reports from various sources. The most circumstantial account given to me was by Mr. George Robinson and his father. These gentlemen tell me that about eighteen years ago when they were living on Gowrie Creek, near Toowoomba, after a heavy flood, the creek was found to be positively swarming with a fish which had been never previously known in that district. So plentiful and voracious were they that the very children could pull them out by the score of an afternoon, using as bait a small worm or piece of meat. It was particularly remarked that these fishes were never caught in the deeper pools, but were confined to the swift running streams where the water was barely sufficient to cover them, but being discolored they were invisible until hooked. The Messrs. Robinson, who, on being shown the Stanthorpe

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(<sup>2</sup>) *Terapon longulus*, Macleay, l.c., p. 367; Fresh waters inland from Port Darwin, Northern Territory.

(<sup>3</sup>) *Terapon elphinstoniensis*, de Vis, Proc. Roy. Soc. Queensland, i, 1885, p. 57; Lake Elphinstone, Queensland.

(<sup>4</sup>) Lake Elphinstone is a muddy sheet of water about six miles long by two wide, lying landlocked between the watersheds of the Nebo and Suttor Rivers, inland from Mackay.

fish, at once recognised in it their old friend of Gowrie Creek, further told me that they rarely grew to a pound in weight, while some were but three inches long, the average being about midway between these two extremes. They added, too, that the fishes were most delicious eating. As Gowrie Creek takes its source from a swamp, it is plain that this incursion of fishes, which may be compared to the hordes of bush rats and mice which occasionally devastate our inland districts, had made their way up Gowrie Creek from the Condamine, into which it flows. Three months after their arrival, when many thousands had been captured without any appreciable diminution in their numbers, another flood came, and on its subsidence it was found that they had disappeared to the last fin as suddenly and mysteriously as they had come; nor, so far as I can ascertain, have they ever again appeared in that locality. It will be very interesting, therefore, to note whether the arrival of this fish at Stanthorpe is the precursor of a sporadic invasion there similar to that which took place at Gowrie eighteen years ago.

The thanks of the community are due to Mr. White, of Pikedale, the collector of the specimen above described, who, on finding that the creek, in which they had so mysteriously appeared, was drying up owing to the prolonged drought, promptly set to work and caught as many individuals as possible, and transferred them to the main river. It is to be hoped that other gentlemen, when brought face to face with a similar problem to that which confronted Mr. White, will emulate his excellent example, and by acting with equal promptitude not only save the lives of scores of useful food fishes, but be the means of disseminating them over a wider area. No praise can be too great to offer to anyone, who, in this country where the great object of many of the inhabitants appears to be how most quickly and surely to exterminate the wonderful native fauna with which the land has been so richly endowed, expends time and money on such a cause, even though, putting utility aside, it be one of common humanity alone.

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# MENTAL DEVELOPMENT IN ANIMALS.

WITH LOCAL ILLUSTRATIONS (LANTERN SLIDES).

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**By HON. A. NORTON, M.L.C.**

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*Read before the Royal Society of Queensland, 4th Oct., 1906.*

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As I walked round what, in domestic language I understand is technically called the "drying ground" at my own home, a few months ago, a small bird suddenly fluttered down beside me from a bushy shrub, and then, with every symptom of fear, it continued to flutter along the ground as though its wing was broken. In a moment there flashed through my mind the remembrance of a time when the world was young; a time when I discussed, with companions of about my own age, this device which many birds practice in order to lure away from their nests the unwelcome human bipeds who they do not wish to interfere with their young. How had birds learnt this trick? we asked ourselves wonderingly. When we sought for an explanation from an older boy, he said, "Why, it's instinct, don't you know?" A still older boy and more learned, told us patronisingly that it was "a hereditary practice which had come to them through their parents from a long lineage of parents' parents." With such explanations we had to be content, for we could get no other; but neither of them settled the question, and we continued still to wonder where or how the birds had acquired the trick. In after years, as I wandered through the country, sometimes alone, often with companions who gave less attention to such subjects than we boys had done, I looked for some better explanation of the birds' sagacity. "Instinct" was not sufficient; for although instinct explains much, there is an obvious

method in their actions; they know they want to lead the intruder *away* from their young, not *towards* them; and they know also when they have succeeded as much as they think necessary.

Are we justified in going somewhat deeper into the subject and asking ourselves if such obviously intentional effort to deceive does not indicate the dawn of thought in what we are pleased to speak of as "the inferior animals"?

Closely associated with this peculiarity is another of exceptional interest. I refer to what is termed "Mimicry in Nature." This faculty, if I may so call it, must be regarded as of twofold character. There is that kind of mimicry by which an animal imitates in its form or colouring something quite different from itself. An insect, for instance, may through a series of gradations resemble more and more closely another insect, the imitation becoming almost complete in the course of evolution extending over a longer or shorter period. This, I am advised, is the case with some butterflies which are greedily sought after by birds, the change in their colour and markings being such as to give them the appearance of other butterflies which birds do not care for; in other respects the distinction between the two is rigidly maintained. I am not sufficiently acquainted with the subject to speak of it from my own knowledge. But we have many familiar instances in which insects assume the appearance of pieces of bark of trees which they frequent. On the trunks of many of our native trees insects may be observed which cannot readily be distinguished at first sight from scales of bark; caterpillars, which represent part of the branches, or leaves, or flowers; locusts, whose colouring readily deceives even careful observers. Very noticeable in this class of mimetic insects are the so-called stick mantis, the leaf mantis, and the leaf butterfly. The mimetic character is found also in shells, crustaceans, spiders, frogs, reptiles, birds, quadrupeds, etc. In most cases the mimicry is acquired without any effort or even knowledge on the part of the imitator; this may be treated as *unconscious* mimicry in contradistinction to that which is intentional and may therefore

be spoken of as *conscious* mimicry. This classification has been suggested by Romanes. In the first-named, the imitation, however it arises, depends upon conditions which cannot be influenced by the mimic, its shape, colour, etc., having been determined before, or at the time it began its career in the world. I propose to show some instances of this kind which are wonderful in their resemblance to the objects imitated; they are taken chiefly from exhibits in the Queensland Museum.

I admit at once the difficulty of drawing a distinct line of demarcation between the two classes I have referred to. This I will try to explain by taking as examples what are familiarly called the stick, or walking-stick, mantis, and the leaf butterfly; the former is commonly spoken of by boys as the "jackstraw." This insect has the dull brown colouring of a dead twig, but the resemblance to a dead or leafless twig is largely aided by the attitude it generally assumes when resting on the branch of a tree or shrub. The leaf butterfly when it flits through the air, shows only the upper surface of its wings, and this in no way resembles a leaf; when, however, it alights upon a branch, it raises its wings so that they close together above its back. The under surface only is seen when it is in this position, and it is the under part of the wings which have the colour and markings from which its name is derived. The head and upper part of its body are raised above the twig, and the front edges of the forewing are brought forward until the insect's head rests against them. The back part of the body, on the other hand, lies close to the twig, and a small projection from the back of the wings just touches it. These represent the leaf stalk, and from that point a line of darker colour extends upwards through both wings until it reaches the most prominent point of the fore wings, the line becoming thinner and fainter towards what thus appears to be the tip of a dead leaf. In this case, while the marking and colour are similar to the object imitated, the effect would not be complete but for the action of the insect. Now, the raising and folding of the wings above the body can scarcely be regarded as a movement designed to complete the deception. The butterfly probably does not know



that the under surface of its wings resembles a dead leaf ; nor does there seem to be any suggestion of *design* in the attitude it takes up. That is one of the habits of its life, and if it had no leaf-like marking, the position it places itself in would probably be the same. The protective colouring and altitude combined have resulted, no doubt, from the fact that they have saved its progenitors, when others of its kind have fallen a prey to their hungry enemies. It is a case of the survival of the fittest, which, continuing with slight variations through generation after generation, has at last become almost identical in appearance with the object imitated. This interpretation of the phenomenon, inferential though it necessarily is, has now been generally accepted.

One case of *conscious* mimicry I have already touched upon in the beginning of this paper. I have observed some very marked instances of this kind among the smaller birds which live by the sea, and lay their eggs in the drift which accumulates just above the high-tide line. Some of these have that mimetic colouring which I have referred to as *unconscious* ; so much so indeed that as they sit upon their eggs they may be passed within a few yards without exciting notice. In some cases their eggs are mimetic in their colouring, while the young chicks are brown in colour and marked with stripes of a darker shade, which extends from the neck lengthways along the body. The effect of this is that when the parent bird by her pretences has induced intruders to follow her away from her young, these can more readily conceal themselves. The eggs of plovers, including the stone plover, or curlew as it is commonly called, are similarly marked, as are also the chicks, while the mother plover is an admirable pretender.

In the case of other animals, the mimicry assumes another form. Many spiders bear a very marked resemblance to the plant they commonly frequent, and some of these construct snuggeries for themselves by so twisting a leaf that its two edges meet ; they then bind these together with their web. I wish, however, more particularly to refer to our trap-door spider (*atrax robustus*), a specimen of whose nest with the trapdoor attached was brought

me not long since by a young friend. The spider, a specimen of which is shown on the slide beside the nest, is a female; we have no male of this kind in the Museum. The male is much smaller than the female, and is looked upon by his mate as an unfit animal to be entrusted with the care of their offspring; so much so indeed, that if he approaches too nearly to the sacred precincts of the nest, she will attack him without mercy. The deep black colour of these spiders contributes to their protection; but the nest is so remarkable that it seems almost impossible to attribute to mere instinct its wonderful mechanical contrivance. For the construction of the nest, the spider sinks a hole almost vertically in the ground. This is lined most carefully with web, through which no sand or dirt can fall. The orifice is covered with the trapdoor as closely as a shell's mouth with a tight-fitting operculum. It, too, is carefully lined with web, the outer surface being made snug with a covering of fine moss. Then the trapdoor or lid is attached to one side of the nest by a strong hinge of web, which admits of the door being lifted without difficulty from within or without. In this carefully prepared chamber the eggs are deposited and guarded by the mother. Spiders are humble animals in appearance, but when the good lady is disturbed while she keeps watch over her offspring, the anxious expression of her eye reveals the fact that a fixed thought fills her mind, and that she is prepared to take immediate action should the occasion for doing so arise. Are we, then, justified in assuming that the careful mechanism of the nest and the fierce determination of the mother to protect it, are the result of instinct unaided by reason?

I will now pass on to other cases which suggest conscious mimicry. With our native pigeons, and I refer particularly to the peaceful little squatter (*geophaps scripta*), a disposition to hide is manifested on the approach of one whose presence is regarded with suspicion. It is impossible not to feel that these birds try to hide, and so firmly do they rely upon the success of their design, that they will scarcely move out of the way of a passing traveller, merely squatting down behind a tuft of grass,

or a stone, or beside a fallen branch until he has gone by. On one occasion a blackboy, who accompanied my stockman in his rounds, cut down three with his stockwhip out of a group of eight. Many squatter pigeons lose their lives in this way, through their too great confidence. The morpork (*podargus*), of which we have several varieties, and of which I exhibit a specimen, forms another marked example. The colour of the bird's plumage and its markings, resembling as they do the dry bark of some of our eucalypts, would, one would think, afford a large amount of protection; but added to this is the conscious mimicry which prompts the bird to place itself in such a position that only an observant passer-by would see it. Even the bush curlew, or stone plover (*œdicnemus grallarius*) will posture in such a manner that it may easily be taken for a stump or part of a fallen branch.

I will now call attention to a different form of mimicry which birds have recourse to. I mean the building of their nests. Passing by the clever arrangements of stick or grass as one of minor interest, I may refer to the mud nests of the common house swallow (*hirundo neoxena*). These they love to build up in our verandas, where they sometimes become a great nuisance. In such positions they are easily seen; but once there were no houses, and then the birds had to look for a hollow in an old tree or in a log; sometimes they build their nests under overhanging rocks, or on the side of a rough-barked tree. In unfrequented localities these may still be found, and it is obvious that the leading thought of the builders has been the concealment of their temporary home.

A yet more remarkable evidence of thought is the playground of certain of our native birds. Many of these are simple structures, made of twigs, placed in an almost upright position, and between too such rough fences the birds amuse themselves by running backwards and forwards. A much more striking one is that which some years ago was found on the Bellenden Ker Mountain; it is sometimes called after (Mr. Archibald Meston,) Meston's Bowerbird (*priondura newtoniana*). I understand that Broadbent, of the Museum, first brought it under notice. In this case, as will be seen by the illustration, the first business

has been to select a tree suitable for the builder's purpose. Around this a number of sticks are piled, the ends so overlapping each other that the tree is surrounded completely, the curious edifice being kept in an upright position by the tree which supports it; shells and moss are freely used for ornamenting it. On and around this structure the birds collect and amuse themselves somewhat after the fashion of children when they play "King of the Castle." The specimen in the Museum is about four feet in height, and two feet in diameter at the base.

I will here quote one other case which seems to indicate a decided reasoning power in birds. I refer to the Laughing Jackass (*Dracelo gigas*). Commonly these birds, soon after daybreak, commence their day's business by chanting, if I may so express it, their peculiar hymn of praise. Then, perched on a tree from which they have an uninterrupted view of the ground, they look thoughtfully round. Suddenly one of them swoops down, having caught sight of an earth-worm, which, after its nocturnal wanderings, has begun to burrow into the sand. It must not be supposed that Jackie clutches the worm with his little feet; his feet are not made for that purpose, but with his strong beak he seizes the tail end of the worm, of which only an inch or two may be visible. Firmly he holds on, not trying to pull the worm back, for then it would break, and he would lose part of it. It is the worm that pulls, but to no effect; then it wriggles, and this brings a little more to the surface. The bird draws his head back enough to take in the slack, and the worm wriggles more, each time it wriggles coming back a little and the bird draws his head back further. At last the whole of the worm comes to the surface, and Jackie makes his early meal. The bird's action and his deliberation supply him with the maximum amount of food which each worm can supply; may not this carefully planned scheme of his furnish us with food for reflection? Are we to accept this illustration as evidence only of instinct, or must we treat it as the result of reason? I am disposed to accept the latter alternative, not merely because of the evidence in that direction which the Laughing Jackass supplies, but because by following the subject further, the evidence of thought and of reasoning power in the inferior animals grows continually stronger.

One phase of mimicry is spoken of as "feigning death." Beetles and moths commonly have recourse to it, and it is said that birds occasionally allow themselves to be handled without making an effort to free themselves. I have not seen it amongst birds, but most old bushmen know how cunningly a native dog will lie as though dead, when he has fallen into the hands of his pursuers. I do not pretend to be able to explain such tricks, for that it is a trick, cannot be doubted. In the case of the dingo, it seems to be fear that excites his cunning, for so well are his devices understood, that his hamstrings are often cut before he is left to himself. It does not seem possible that he can understand the meaning of death.

Some years ago a curious case came under my notice, and I may as well place it upon record here. In some paddocks near Gympie which I at one time rented, was a roan milker that I had had brought down with other cattle from my Rodd's Bay Station. Her dam was a fairly well-bred Durham cow, her sire a three-quarter bred Durham and Devon, the latter predominating. After she had been in the Theresa Vale paddocks for eighteen months or two years, she gave birth to "identical twin" heifers. Oddly enough, these in their general character were like the wild Chillingham Park cattle. In colour, they were creamy-white, with black muzzles; the inside of the ears and about a third of the outside from the tip downwards was red; the horns, as the calves grew up, were white, with black tips turned upwards, and they were small in diameter; a distinct case of atavism. The mother was unused to taking care of more than one calf at a time, but at first she took kindly to both. When two or three days old, however, one of the calves crawled through the paddock fence, and wandered away with some other cattle. Two days later, my stockman, Phil Rafferty found the waif, and brought it in, but the mother then refused to let it come near her. The forlorn little creature was therefore allowed to take milk from its mother when she was in the bail; this she resented, and always tried to kick and butt the unfortunate when she had a chance. Having other milkers, old Phil let the calf suck them also when they were in the bail, and it soon grew and equalled

its sister in size and condition. Still the mother hated it, and she gave all her love to the other. One day, however, a notable thing happened. Both twins had been let loose in the yard before their mother was released from the bail, but no sooner was she free that she rushed at the waif as she thought, and knocked it over. Then, and not until then, she discovered her mistake; it was the child of her affection that she had knocked down. Poor Daisy was greatly disconcerted at the untoward event, and the end of it was she let both calves take her milk, and afterwards treated them as equals.

In no other instance have I observed so marked a resemblance between twin calves that their mother found a difficulty in distinguishing between them even when their size and condition were practically equal. That the cow, having made a mistake, should afterwards have received the twins on equal terms, suggests to my mind a further explanation than that afforded by instinct. For the first time, apparently, she realised how greatly they resembled each other; and how could she continue to make a difference between them when she could not with certainty distinguish between them.

The atavistic phenomenon in this instance is remarkable, the two calves showing so plainly a resemblance to an ancestor from whom they must have been separated by at least several generations. The circumstance, however, emphasises a fact which is often allowed to pass without comment. In the prosecution of their business, breeders of pure bred stock have discovered that by "in-breeding" certain marked characteristics may become "fixed"; not absolutely fixed, but fixed in a majority of cases, and some of them have persevered in an otherwise pernicious practice with the expectation of increasing that majority with each cross. It is in this way probably that the types of each class of wild animal has become a type. But "in-breeding" has its disadvantages also, for by the crossing of near relatives, the characteristics which it is desired to breed out, may also be developed, and reversion to the original type may be effected unintentionally. I refer to this aspect of the case, because where the instinct or the mental power of animals are looked for as the result

of careful crossing, there will be some cases of reversion to the ancestral type. On the whole, however, there seems to be a continuous increase in the intelligence of animals, which, having been carefully trained, are brought together under a well-considered scheme of selection. We find amongst all classes of domesticated stock a generally continued advance, both physically and mentally. I do not propose to mention many cases to illustrate my contention. Most of us, I suppose, can call to mind some facts in connection with this phase of the question. Breeders of horses are aware that certain strains of blood are likely to lead to the development in individual animals of greater sagacity than is common to all. In the case of dogs this is particularly noticeable. One old cattle dog I had, when I lived at Rodd's Bay, knew as well as any of us when a bullock was to be slaughtered. He was full of excitement when cattle, including a beast for slaughter, were driven into the yards where the killing took place. He anxiously watched the men as they ground the knives, and collected the required butchers' implements; and, other preparations having been completed, he waited outside the back door of the house until I came out with the gun. Then, with marked approval, he excitedly preceded me to the slaughter yard. So far as one could judge from his actions, there was no detail which the old fellow did not know and keep in his mind. So too, an old cat. As a rule he waited at the garden fence, and looked towards the yard in which were the cattle; but when I walked down with the gun, he perched himself on top of one of the posts and there awaited my return, expressing in his own feline fashion his thanks for the feast of fresh beef which I brought back with me. Most people have read or heard of the marvellous intelligence of sheep dogs and cattle dogs. I will limit myself to two cases.

A friend of my own, named Brown, went to Gloucester, in New South Wales, to select some cattle which he wished to purchase. One of the stockmen went round with him to collect the cattle in a large paddock. This man made signs to his dog, and told him what was expected of him. He rode up one side of the creek with Mr. Brown; the dog

went across the creek alone. After two or three hours riding the cattle were all put on to their camp—by the stockman on one side of the creek, by the dog on the other, the work having been done quietly and without excitement. Mr. Brown's offer of a first-rate horse in exchange for the dog was instantly and unhesitatingly refused. The dog was not only well-trained, but had well-bred parents of exceptional intelligence.

When I lived on New England, the sheep were washed in a somewhat primitive fashion before being shorn, the yards by the washpool not being too well constructed. On one occasion, Alexander Grant, a Highlandman, who spoke the Gaelic, came in with a flock of strong wethers, one of which jumped the yard, and was immediately chased by two or three yelping curs, which seemed intent upon hunting the wether into the bush. Sandy and his dog were, however, equal to the occasion. The dog understood no language but the Gaelic, but he obeyed the words of command as his master yelled at the top of his voice. Sometimes pressing in close to the wether, at other times keeping wide, according to instructions, he brought it back to the yard and through the gate in spite of the yelping curs which persisted in getting in the way. This dog was not by any means well-bred ; on the contrary, he had the appearance of having a kangaroo dog for one of his parents. Most of us who have had to work a sheep station know how wonderfully collies do their work, and how collie pups which have never before had anything to do with sheep, will take to it—"instinctively," we usually say—when they see sheep for the first time, although they have not been with their parents or any other sheep-dog from the time they could lap milk for themselves. Are we justified in speaking of this as instinct ? Can the inheritance from their parents of an acquired knowledge be regarded merely as instinct ? Even if it be instinct, it is instinct of a far higher description than that which comes as an inheritance from untaught parents.

The cases I have quoted may not immediately concern us who are here this evening, even if they are accepted as evidence of that mental development which I believe the lower animals are capable of. We know, however,



that they have mental qualities, memory and thoughtfulness, for which they rarely get full credit, and that in innumerable instances they exhibit a bright intelligence which surpasses that of many human beings. That, under natural conditions, they do not display this to a larger extent is not surprising. For untold ages, man, with his higher type of brain, made little advance, and was scarcely superior to some of the animals amongst which he lived; and even now the world contains tens of thousands of savages who are almost as ignorant as the beasts. Keeping in mind, then, the vastness of time which must have elapsed before the human race had begun to feel their way through the darkness which enshrouded them towards the approaching dawn of civilization, shall we shut out from our hearts the hope that a brighter time may come for what we regard as the inferior animals, a time when their advancing mental powers will insure for them a larger share of consideration from mankind than they now receive. Of one thing I think I may speak with some certainty; it is, that those who love animals most will heartily join me in the hope that the suggestions I have given voice to to-night may not be without some justification, but that the mental development of the lower animals will, in course of time, raise them to a higher plane by means of which their enjoyment of life will be increased, and their place in nature materially advanced.

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# NOTES ON AN APPARENTLY NEW SPECIES OF HYALINE DAPHNIA.

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**By W. R. COLLEDGE.**

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In examining the pond life around Brisbane, I have found a very interesting and unusual species of Hyaline Daphnia. A great deal of systematic work has been done on these insects in England, Europe, and the States of America. But none of the forms illustrated resemble this species. It stands out distinctly from all others by its peculiar shape, and unusual size. The same species has been noticed in Victoria by Mr. Hallam, the Secretary of the Hawthorne and Camberwell Microscopical Society, but that is the only reference that I have been able to find upon the subject.

The Daphnias, or Water Fleas, belong to the order of Entomostraca, or shelled insects. The branched antennæ places them in the sub-order of the Cladocera. The Hyaline species were discovered by Professor A. Lehdig, in the Lakes of Switzerland, and are so named on account of their pellucid character. Seven species are known in England, and two more in America. The variations of form in each species is considerable. The typical character, of which I give an illustration taken from the Year Book of Microscopy, is "Daphnia Hyalina." Two other forms are also figured from America. One from Lake St. Clair, the other from Lake Gogebic. Some of the varied forms that have been noticed may be of the same species, only taken at different periods of their development. Their transparency renders them objects of great interest, as

their internal anatomy, the process of deglutition, mastication of food, its progress through the gullet into the stomach, the perisaltic movement of the digestive canal, the beating of the heart, and the circulation of the blood, are all visible under the microscope.

The peculiarity of this species is, the enormous prolongation of the posterior part of the head. This organ occupies fully two-thirds of the body of the insect. A line drawn from the point of the beak to the occiput, would form with the upward curve, a half-circle. The whole body is compressed, more especially its cephalic portion, the sides of which are almost in apposition, so that it resembles a thin sharp plate growing a little more convex at the base of the antennæ. The anterior part is prolonged into a sharp curved beak. The body below this forms a somewhat obtuse angle. On the dorsal line projects a long, serrated shell spine. This is straight, but occasionally curved, and sometimes the tip is broken off, this has been the case in Figure No. 1.

The representatives of the superior antennæ (unless these are olfactory setæ) are found in two flask-like cells, bearing each a bundle of papillæ, and situated on the inferior border of the beak, about one-third from the point. The edge of the beak from here to the brain is thickened, probably by nervous structures.

The second antennæ, as in all species of this order, are highly developed. The broad, flat, radiating muscles which unite them to the inner carapace are very prominent. The basal joint is large and rounded. From it proceeds two branches, each having three joints, the first being the longest. Each extremity is adorned with a serrated collar. From the inferior border of each joint droops a filament very delicately feathered, the end joint possessing three of similar character. These organs are their means of locomotion. Being of greater specific gravity than water, and so compressed, they offer little resistance to the force of gravity, and naturally sink to the lower depths, unless they actively use the antennæ. These organs project forward, separated by an angle of about 45 degrees. They progress by a series of short jumps. During daylight they are usually found in the deeper parts of lakes.

but in the morning, and towards evening, likewise on cloudy days, they may be found near the surface. I have noticed that frequently a little air finds admission beneath the shell in some instances, and they seem to lie in consequence helpless on the surface of the water. The outer carapace covers the whole head and body in one piece. It is thin and transparent, of a reticulated structure, the cells being square, and occasionally, of oblong forms. It is open frontally from the base of the second antennæ down to near the origin of the shell spine. Within this, is a second shell free over the abdomen, united dorsally, and lining the whole of the cephalic portion. It is denser than the outer coat, and is dotted with stellate and irregular marks. It contains on the pleura the convoluted shell gland. On turning the flaps of these two coats back, there is seen the branchial feet. These consist of five pairs ranged on each side of the abdomen. The first, second and fifth differ from each other, but the third and fourth are somewhat similar in structure. The muscular portion is formed like an elongated plate, while from the outer edge droops a deep fringe of closely set setæ. In the third and fourth pairs there are nearly a hundred lying side by side in one foot, all set at a regular distance from each other. Under a high magnification, each proves to be a delicate feather, so airy and perfect as though it belonged to some fairy world, such as Shakespeare imagined in his dreams. Each edge of these dainty elfin feathers slightly overlaps its neighbour, thus presenting a close network to the water. At their base the filaments are united each to its neighbour. Ceaselessly do they move with a graceful rhythmic movement. An essential part of their work is to supply the respiratory pouches with fresh currents of water, but a no less important function they have is in procuring food. The continual motion creates a current, which sets in towards the body.

Vegetable spores, volvoces and other minute organisms, which serve as food, are borne along by it. The water filtering through the fine network leaves the residue beneath the first and second pairs of feet. If the mass is too large, or not good for food, then the tail-piece, armed with its two pectinated claws, is drawn in between the two rows

of feet until it rests against the abdomen, then it is forcibly thrust out, expelling the material into the water. On the contrary, if the residue is suitable, then the labium or upper lip, shapen into a broad fleshy plate, with bordered hairs, and hinged by its upper part to the chest, is lifted, and a portion of food enters the mouth. The lip, like a trap-door, then falls down over the orifice. Beneath lie a pair of minute but powerful jaws, with four semi-circular teeth, directed towards each other. These tear the mass, and force it towards the mandibles. These are peculiar in shape, and interesting in their operation. They lie parallel, and in front of the alimentary canal. In shape, conical, with the extreme point pivoted, leaving the body free to rotate. The sides of the cones which face each other are somewhat flattened, but basally are rounded, and hardened with chitine. On the ends of each, which face, is developed a hard oval plate, grooved with parallel bars, three stout teeth also project on the edge. A second set of teeth in the form of a comb, with the longest teeth set in the centre, the others gradually diminishing as they approach the sides, is set at an angle of about thirty degrees from the surface. By the action of the jaws, the food is forced towards these rasp-like plates and teeth. Then there comes into play a peculiar muscular mechanism. The cones, pivoted at their further pointed ends, and held in place by bands of muscles, are given a quarter of a revolution in one direction; then reversed in the opposite way, and so they rock back and forward, with the regularity of a pendulum. By this means the food is crushed into a fine pulp. As I watched the process there came to mind the quotation:—

“The mills of God grind slowly,

But they grind exceeding small.”

On the inner surface of the labium the œsophagus opens, and ascends to the large curvature of the digestive canal; throughout its length, thick, transverse muscles surround it.

By their contraction the comminuted food can be seen forced in little jets on its upward way to the stomach. On the back of the labium, a stout cord-like muscle rises in the median line. At its origin is a tuft of tactile papilla, continuing to the head it divides, a branch running to each

side of the beak for a considerable distance before insertion. It is evidently the adductor muscle of the organ. The digestive canal commencing in the lower portion of the head curves upwards, where it receives the ends of two tubes, the hepatic diverticula. Its walls are thick and muscular, the central cavity being small in comparison. In health it is always undergoing a rhythmic contraction and expansion, the movement commencing anteriorly, and continuing the whole length of the canal. The lower end of this is closed by a strong sphincter muscle, which opens into a second oval cavity terminating in the anus. The aperture for the ejection of the contents being placed at about the fifth tooth of the telson.

The dark eye is very prominent. It consists of a large mass of black pigment, and on each side seven or eight lenses are placed on the lateral periphery. In some of the English species the lenses are more numerous. The organ seems to rest in a large cavity, and is not fixed, for it can be rotated to some extent, the motion giving it a characteristic tremulous appearance. A bundle of muscles and nerves connect it with the brain, and on the latter is seen the macula nigra, or eye spot. This is absent in some forms.

One of the most noticeable things about it is the movement of the heart. It lies near the dorsal line on the opposite side, and in a line with the beak. Oval in shape, it is quite transparent, and furnished with strong, circular and longitudinal muscles. It contracts with great rapidity. There are two slits in a transverse direction on the opposite sides. In contracting, these slits are closed, and the blood is forced into an arterial vessel, which curves backwards to run by the side of the digestive canal. No general venous system is traceable, but the blood, which is colourless, can be traced by the particles which float in it. There is a canal proceeding from the region of the heart towards the lower part of the occiput. Along this the blood flows, and passes by a channel formed around the edge of the carapace by the juxtaposition of the inner shell. Around the eye a broad current flows, freely bathing all the tissues.

The *ovaries* or *egg sacs* lie along the abdominal canal, a duet opens from them into the space on the back, called

the Brood Pouch, beneath the outer shell. There they remain until they are hatched, and the young are able to care for themselves. The eggs at first are round, with a central nucleus surrounded by oily globules. Gradually they elongate, and the young insect assumes shape, and gradually matures. Ultimately they may be seen moving independently in the pouch. A curved hook, arising from the back of the tail-piece, keeps them imprisoned. When the mother considers them old enough to fight life's battle, she lowers the hook, and the young slip from their nursery into the water. When newly-born, the long shell-spine is bent round the abdomen, the tip being attached to the back of the head. This is freed in a few hours by its struggles, leaving a little ragged spot at the point of its attachment. The spine now looks so long that the body seems disproportioned to it. Gradually it assumes a more natural shape, and in two days is like the third form depicted. So far there is no sign of the peculiar elongation of the head, so characteristic of this species. It approaches the shape of species found in Lake Henrietta, in America.

At intervals of growth, the whole of the shell with the coverings and feathered setæ of the feet are thrown off entire, and within seven days the peculiar form of the head appears. At first, it is not quite so pronounced, but grows more so at each successive moult. There is a good deal of variation in individuals in the depth of the cephalic curve, and also in the length and curve of the shell-spine.

In England, and on the Continent of Europe, about the month of October, they begin to lay a different kind of egg. These are called the winter or Ehippial eggs. A dark saddle-shaped organ begins to form on the back; it bears, usually, two very large elongated eggs. This saddle slips off at the next moult, and either floats, or sinks down into the mud. I have found these eggs floating among the decaying refuse on the surface of a pool. In cooler climates they remain during the winter, their covering being sufficient to protect them from the frost, until favourable conditions occur, when development begins, and the insects once more appear. It is somewhat peculiar that in the month of September, when I began to find them, many of the females bore their usual summer eggs, but

in October, some were found bearing the winter eggs, and these increased rapidly until the majority were of that kind. Then the insects disappeared for nearly five months. It seems a peculiar coincidence, that the same changes they undergo in colder climates should take place here, under such opposite conditions. My own observations may be of too limited a nature to form a general conclusion, for I have only found them in one place, and in one pool; but the fact is interesting, and doubtless, will help to direct attention to them in the future. Unfortunately, their entire disappearance has prevented the continuance of my observations for the present.

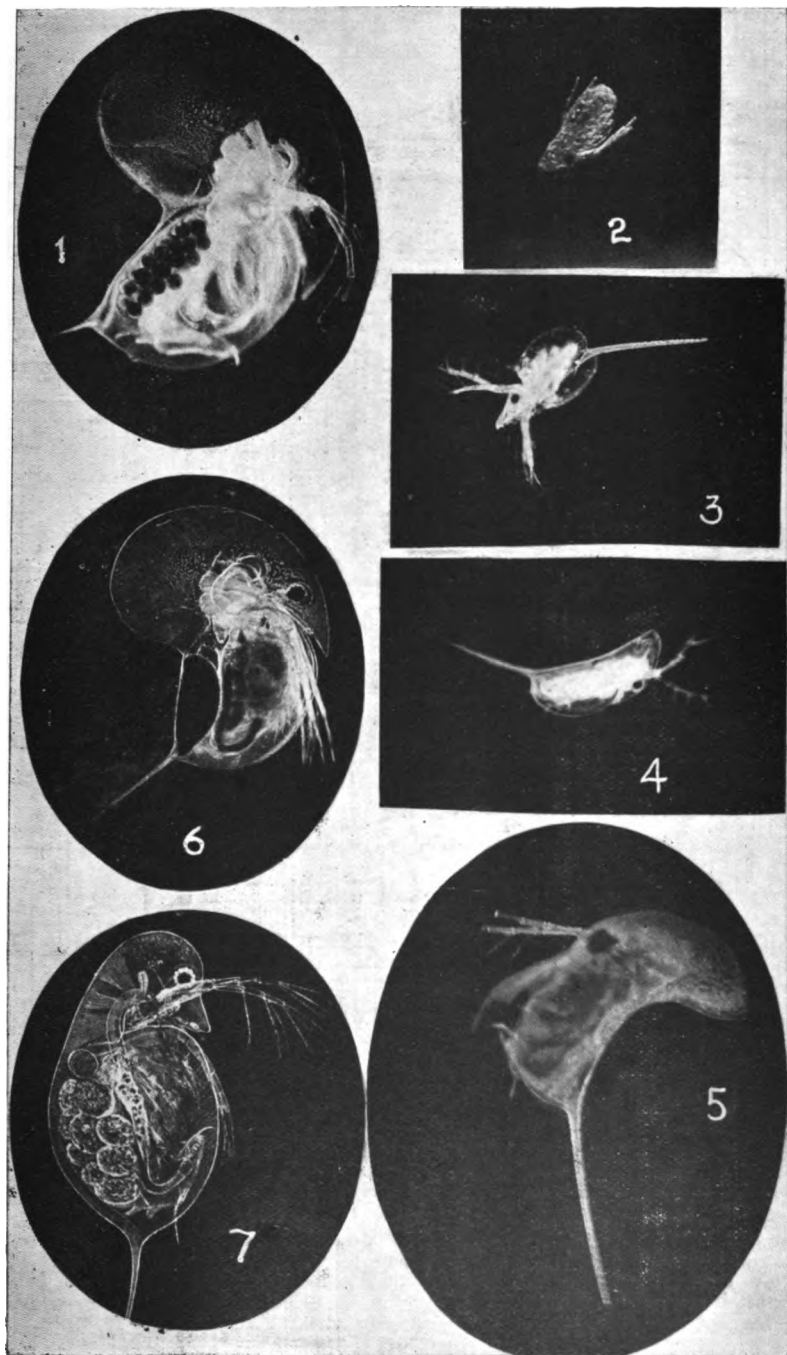
#### Measurements of Hyaline Daphnia—Brisbane Species :

	Millimetres.	Inches.
Across Head from beak to occiput	2·9 mm.	·116
Length of Body, excluding Shell-spine	3·73 „	·1492
Length of Shell-spine .. .. .	2·x·066	·08x·00264
Telson or Caudal Lamina .. .. .	1·3	·052
Length of Pectinated Claw only ..	·9	·036
Antennæ .. .. .	2·66	·1064
Eye .. .. .	·9	·036
Heart .. .. .	·43x·33	·0172x·132
Mandible .. .. .	·62x·13	·0248x·0052
Jaw .. .. .	·2	·008
Length of third Branchial Foot ..	1·1	·044
Length of Fifth Branchial Foot ..	·9	·36
Length of New Born Daphnia ..	·4x·26	·016x·0104
Length without Shell-spine when twelve hours' old .. .. .	·7	·028
Length of Shell-spine when twelve hours' old .. .. .	1·1	·044

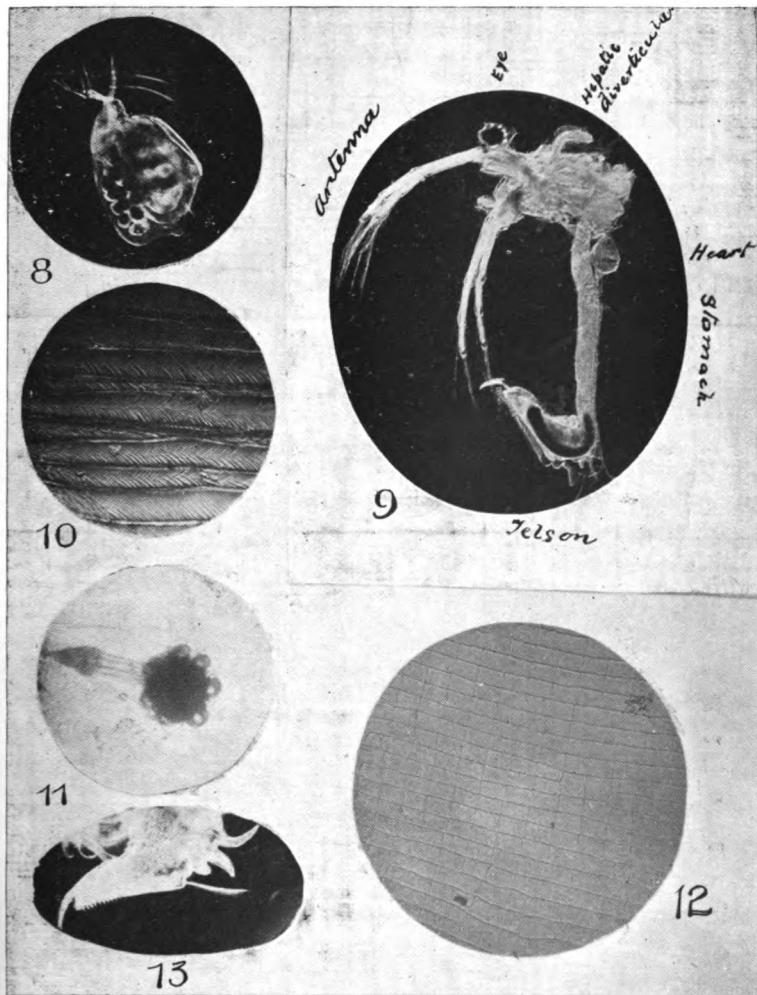


## List of Illustrations of Hyaline Daphnia :

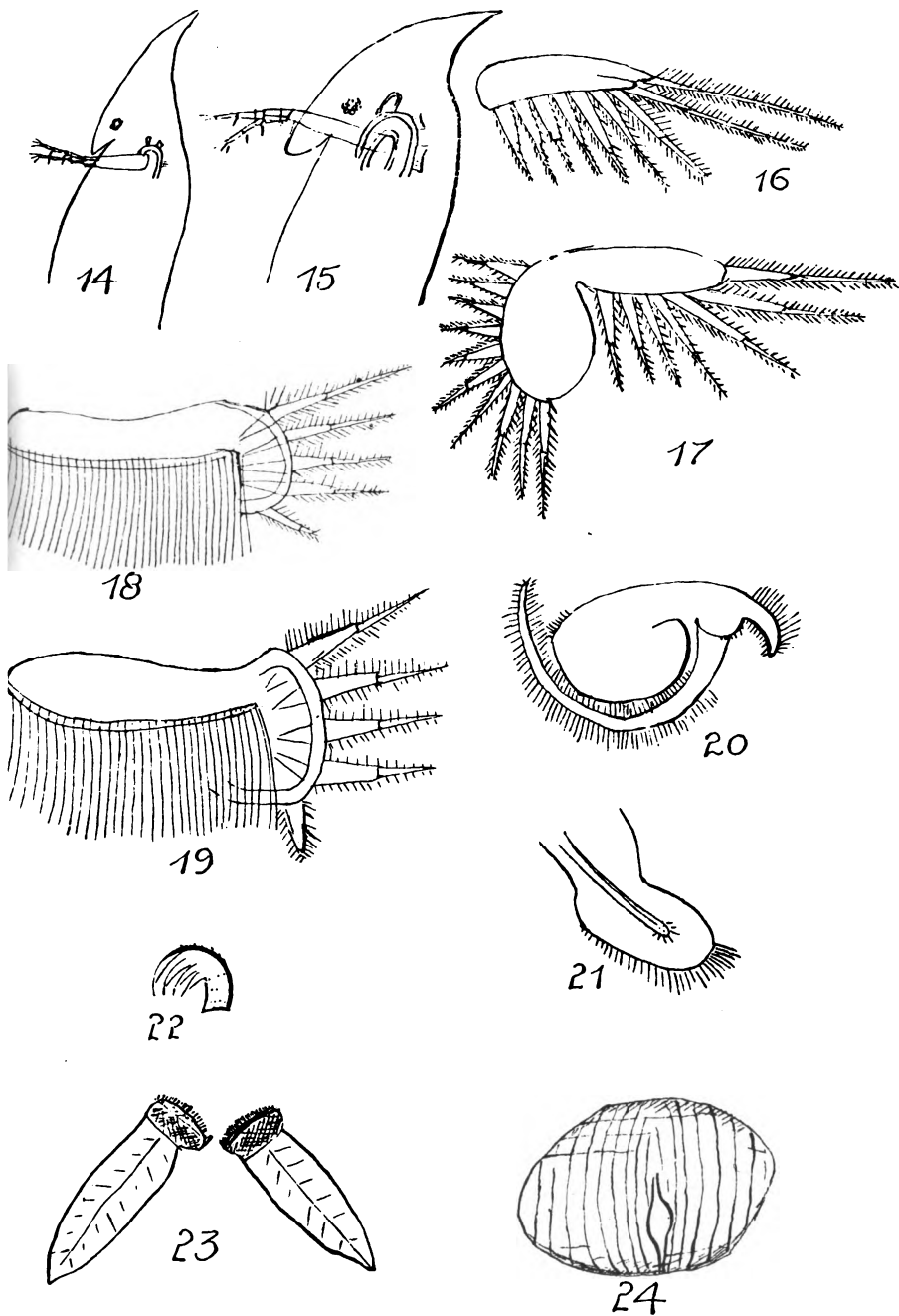
1	Daphnia Hyalina	x 10
2	" "	New born x 20
3	" "	12 hours old x 20
4	" "	2 days old x 20
5	" "	7 days old x 20
6	" "	With Ephippium, Brisbane x 10
7	" "	Typical European Species
8	" "	Common Daphnia Pulex x 10
9	" "	Antennæ, Digestive Canal, Heart, etc.
10	" "	Fringe of No. 3 Foot x 200
11	" "	Eye with Nerves
12	" "	Reticulation of Outer Shell x 158
13	" "	Caudal Lamina x 20 (with Serrated Claws)
14	" "	Lake St. Clair form, U.S.
15	" "	Lake Gogebic form, U.S.
16	" "	First Branchial Foot
17	" "	Second Branchial Foot
18	" "	Third Branchial Foot
19	" "	Fourth Branchial Foot
20	" "	Fifth Branchial Foot
21	" "	Labium
22	" "	Jaw
23	" "	Mandibles
24	" "	Heart













# QUEENSLAND GEMS.

By **MAJOR J. R. SANKEY.**

*Read before the Royal Society of Queensland, 22nd December, 1906.*

I FULLY appreciate the honour paid me when asked to read a paper before this Society, but I do not come here as a scientific man, I merely bring forward a general knowledge of the Precious Stones of Queensland, acquired during many years of working amongst them. I am convinced that Queensland contains a greater variety of gem stones than any other country in the world, the following being a list of those which have come to me from different parts of this State, all of which have been authenticated, and which leave a very small balance of the full catalogue of precious stones known to be accounted for :—

Actinolite (Cat's Eye)	Carbuncle (Garnet)
Adamantine Spar (Corundum)	Carnelian (Quartz)
Adularia (Moonstone)	Cassiterite
Agate (Quartz)—	Ceylanite (Spinel)
Eyed	Chalcedony (Quartz)
Fortification	Chrysoberyl
Banded	Chrysolite
Moss, etc.	Chrysoprase (Quartz)
Almandite (Garnet)	Cinnamon Stone (Garnet)
Amethyst	Citrine (Quartz)
Quartz	Corundum—
Sapphire	Ruby
Asteria—	Sahppire
Quartz	Oriental Emerald
Sapphire	Oriental Peridot
Avanturine (Quartz)	Oriental Amethyst
Azurite	Oriental Topaz
Balas Ruby (Spinel)	Asteria or Star Stone
Beryl—	White Sapphire
Aquamarine	Orange Sapphire
Emerald	Adamantine Spar
Bloodstone (Quartz)	Particoloured Sapphire, etc.
Cacholong (Quartz)	Diamond
Callainite (Turquoise)	Emerald



Fluor	Quartz
Garnet	Bloodstone or Heliotrope
Grossularite	Cairngorm
Cinnamon Stone or Hyacinth	Cat's Eye
Pyrope (Ruby Garnet)	Chalcedony
Almandite (Carbuncle)	Chrysoprase
Gold	Citrine
Gypsum	Hyaline
Alabaster	Jasper
Satin Spar	Moss Agate
Selenite	Morion
Heliotrope—(Bloodstone)	Onyx
Hyacinth (Zircon, Garnet)	Plasn a
Jacinth (Zircon)	Prase
Jargoon (Zircon)	Rock Crystal
Jade	Rose Quartz
Jasper, various	Sagenitic
Lapis—Lazuri	Sard
Malachite	Sardonyx
Marble	Water Bubble
Mocha Stone (Quartz)	Rhodonite
Moonstone	Ruby
Morion (Smoky Quartz)	Serpentine
Obsidian	Spinel
Olivine	Almandine
Peridot	Balas Ruby
Onyx	Rubicelle
Opal	Sapphirine
Precious or Noble	Pleonast
Harlequin	Topaz —
Pin-Fire	Gouttes d'Eau
Flash-Fire	Blue
Black, etc.	Green
Cacholong	Yellow
Wood	Pycnite
Girasol	Tourmaline—
Hydrophane	Green
Seni-opal, etc.	Indicolite
Pearl	Schorl
Peridot (Olivine)	Turquoise—
Plasn a (Quartz)	Blue
Pleonast (Spinel)	Green
Pyrope (Garnet)	Zircon—
Quartz	Hyacinth
Agate	Jacinth
Amethyst	Jargoon
Asteriated	Green
Avanturine	Limpid
Basanite (Lyidian or Touch-Stone)	

**DIAMONDS.**—In considering the stones of the State, I will commence with the diamond, being the most popular of all gem stones.

Hardness, 10.

Fracture, conchoidal.

Lustre, Adamantine.

Composition : Carbon,

Thirty-five years since, the firm of Flavelle Bros<sup>r</sup> purchased a rough diamond, found at Stanthorpe, for £30 ; from time to time other rough diamonds have been found casually, but no systematic working appears to have taken place. The writer recently purchased a rough diamond, of four and a-half carats, which had been picked up by a washerwoman in the bed of Quart-Pot Creek.

Mr. Barton, M.L.A., representing Stanthorpe, has recently exhibited several good diamond crystals found at Stanthorpe, weighing from one up to about five carats.

A diamond matrix, such as that existing in South Africa and Brazil, has not yet been discovered in Queensland, but it must be borne in mind that beyond casual exploration, such as that carried out by Professor Skertchly, of the Queensland Geological Staff, no determined effort has been made to find where the stones, casually picked up, have come from.

One or two small diamond crystals have been found at Anakie.

The diamonds found in this State, so far, have not been of sufficient value to cause any excitement, and this, together with the fact that the European gem merchants, in repeating the tactics which their class had in turn applied to the diamonds of other Countries, that is, accusing them of inferiority, has probably hindered exploration.

In 1772, when diamonds were found in Brazil, the report was spread that they were very inferior, that, in fact, they were the refuse stones from India, which up to then had been the main source of supply ; this was combated by the mine owners sending the stones to India and obtaining Indian values, after which Brazilian diamonds were admittedly the choicest stones. Then, with the discovery of diamonds in South Africa, a repetition of this treatment came and Cape stones were stated to be "no good," and the story was so well believed that every person buying a diamond of any size wanted a guarantee that it was a "Brazilian." The African miners then sent their stones to Brazil, to be forwarded to Europe, and so overcame the opposition. Now, in the same way, Australian diamonds are said to be "inferior" and unworthy, and

the European merchants decline to manufacture the stones, to use their own term, while at the same time they offer to buy all one can send at their own price, which is about half what they pay for Cape stones. No doubt, it is only a matter of a short time before the Australian diamonds will be admitted to be what they really are—that is, good stones, and this little encouragement will stimulate the search for diamonds.

So far the diamonds found have been of very good colour.

**SAPPHIRES.**—Next to the diamond, in hardness, comes the corundum, which includes the sapphire, the ruby, the oriental amethyst, the oriental topaz, the oriental peridot, etc., etc. Corundum crystallizes in the six-sided prisms belonging to the hexagonal system, but gem stones are chiefly found as rolled pebbles.

The specific gravity is 4, about. The lustre is vitreous, but the basal planes are occasionally pearly.

Composition.—Alumina.

The stone is strongly Dichroic.

Sapphires were first discovered in Queensland by Mr. A. J. Richardson at Anakie, in 1873, since when they have been found at many other places, including Stanthorpe, Herberton, Nanango, Logan River, Kilkivan, Johnstone River, etc.

The only systematic mining for the gem is at Anakie, where over 400 miners are at present engaged in the industry.

The Sapphires at Anakie are of every shade of blue, of green and of yellow, many of the yellows and greens are equal in quality to anything the world produces, and, in my opinion, no finer gems exist than the brilliant limpid-yellow sapphires of Queensland. They combine the brilliancy of the diamond with most beautiful shades of rich golden-yellow, and occasionally appearing of true orange colour. The green sapphires are most remarkable for the great variety of their tints, ranging from very pale green through all the shades of bronze, olive, and russet to bright green, bordering closely on the emerald, and continuing into the deepest luscious greens, and all combined with brilliancy.

The blue sapphires are not equal to those of Siam, and they have received a bad name owing largely to defective cutting. I have possessed royal velvety-blue Queensland sapphires, equal to any I have ever seen from other Countries.

Parti-coloured sapphires are frequently found, many blue stones having strange triangular markings of yellow due to peculiarities of crystallisation.

On the whole it may be said that the sapphires of Queensland are now equal to those of any other part of the World.

Very large stones are found, and recently some of high value have been unearthed. It is reported that within the last three months £250 was refused for a rough yellow sapphire on the Anakie field, the miner sending it to London, with a reserve of £500.

Queensland also produces star sapphires. These have a silky structure which, by cutting *en cabochon*, develops a 6-rayed star of wavy light.

The Queensland sapphire has had a hard struggle (commercially) for existence; only a few years ago leading residents of Queensland declared openly that it had neither beauty nor value, and nearly the whole jewellery trade was against it, but, fortunately, its claim to beauty is now recognised. Buyers from all parts of the World are visiting Anakie, and a great future awaits the gem.

“Finger-Ring Lore,” by William Jones, F.S.A., referring to the sapphire as the ecclesiastical gem, says “Cardinals, on their creation, receive a ring, in which is usually a sapphire.” Amethyst, however, is more the favourite episcopal ring-stone.

Allied to, and in very many cases overlapping, the above description of Queensland sapphires are:—

Oriental Amethyst, which is frequently a combination crystal of ruby and sapphire, in alternate layers of red and blue, thus producing a rich purple.

Oriental Emerald, which is the green-sapphire, color as near as possible to that of the Emerald.

Oriental Peridot in like manner, is sapphire with the color of peridot.

Yellow Sapphire is sometimes known as the oriental topaz. Other varieties of sapphires are also occasionally known as oriental jargoon, and oriental hyacinth.

Rev. C. W. King writes—"Episcopal rings were usually set with sapphires, probably from a popular belief that this precious stone had the power of cooling love, owing perhaps to the coldness of its touch, due to its density." The real symbolic reason was the heavenly-blue colour, which denoted celestial purity.

Corundum (RUBY).—The true ruby has been found in this State at Anakie, Stanthorpe, and near Herberton; colors have been good, but stones not large; however, quite sufficient indication that the genuine gems are there.

The true pigeon's-blood ruby is at present the most valuable of gems, and it is to be hoped that miners and others will miss no opportunities of discovering them. Like all corundum, they are six-sided pyramidal crystals, and, owing to their beautiful bright pink color, cannot well be mistaken. When last in London the writer was shewn a flawed ruby of  $4\frac{1}{2}$  carats, valued at £250. The merchant stated that if free of flaws, £1,000 could be easily obtained for it.

At present Burma is practically the only source of the true ruby, those of Siam being far inferior in color. Though even these surpass those of Montana.

Every assistance and inducement should be given to our miners to persevere in their search for this gem, as the discovery of fair-sized stones of good color will probably do more towards the development of gem-stone mining within the State than the finding of large stones of any other gem.

ZIRCON.—Composition: Zirconia, 67%; silica, 33%.

Hardness, about 7.5.

Crystalline system, Tetragonal.

Color ranges from pure limpidity, like the diamond, through all yellows, browns and reds.

Different varieties are known as jagoons, hyacinths, jacinths, cinnamon stones, etc.

Owing to their extraordinary lustre, small white zircons are frequently mistaken for diamonds, but the difference in hardness is sufficient to distinguish them.

Many very fine hyacinths have been found on the Anakie field, and stones have been cut up to 24 carats in weight.

Zircons are found at Anakie, Nanango, Toowoomba, Stanthorpe, Herberton, Eungella, Boonah, and many other places in this State.

Owing to the richness of color, the great range of delicate hues, combined with its fire, which comes next to that of the diamond, the zircon is an exceedingly attractive gem, and will no doubt soon become very popular. Owners of good zircons should be careful not to mix them with sapphires, rubies or diamonds, as, owing to their interior hardness, they may be easily scratched.

So little is known of the distribution of gem stones in Queensland that it may be mentioned that zircons, sapphires, topaz, garnets, tourmaline, crystal and calcedony may be picked up in the gravel of any railway platform between Brisbane and Ipswich at the present time.

OLIVINE.—Composition: Silica, 41; Magnesia, 50; Ferrous Oxide, 9.

Hardness 6.5.

Spec. Gravity, about 3.4.

Crystallizes in the orthorhombic form.

Color, rich leek green.

It is essentially the gem of basalt.

Found in Queensland on the Main and MacPherson Ranges, and also in the Logan District, and may be sought with fair probability in any basalt country.

This is a most lovely green gem, and is frequently mistaken for the emerald, the difference being that while the emerald is a bluish green, the olivine is a rich golden green.

This gem was very popular early in the 19th Century, but, owing to the turn of fashion's wheel, it fell into disfavour, but again became popular at the time of the Queen's Diamond Jubilee.

**PERIDOT.**—A variety of olivine of a delicate green yellow, sometimes spoken of as the “evening emerald.”

The antiquity of this gem is proved by the following passage in an old book—“Adam Sadbury, 53rd Abbot of Glastonbury, gave to the Abbey, among other precious gifts, a gold ring with a stone called peridot, which was on the finger of St. Thomas the Martyr, when he fell by the swords of wicked men.”

**PEARL.**—Probably the pearl is the best known of all gems to Australians.

For many years Queensland has produced thousand of pounds worth of pearls.

The oyster fisheries of Thursday Island have been the chief source of supply, but pearls are found practically right round the coast, many good pearls having been found even in Moreton Bay.

Prior to the Japanese War, pearls brought very high prices, running to hundreds of pounds, according to size, lustre and perfection of shape, good symmetrical lustrous whites of good orient are always in demand, and both black and white pearls of good color, shape and lustre always command very high prices.

The most remarkable pearl the writer has seen was a pearl blister, exactly like a small crayfish. This was described to Mr. Saville Kent, the great expert, who also owns a similar one, and says that it undoubtedly is an embalmed crustacean, having been coated by the oyster with a nacreous shroud.

**OPAL.**—Composition: Hydrous silica.

Proportion of water, from 2 to 13%.

Hardness, 5.5 to 6.5.

Spec. Gravity, 1.9 to 2.3.

The opal is par excellence the Queensland gem, and is found throughout the Western Districts of the State, from Kynuna to the Southern border.

The value of the opal, so far found in Queensland, has in all probability reached the sum of a quarter of a million pounds. It is found in most picturesque country, the isolated flat topped hills weathered into the appearance of ancient fortresses recall all one's recollection of the romantic history of feudal times.

The name of Herbert Bond is closely associated with opal mining, he having developed the industry by floating a company in London, and so getting capital to work the mines.

Mr. C. V. Jackson, in his official report on the opal mining industry says: "Precious opal occurs in Queensland in two geological formations, viz.: In sedimentary rocks of upper cretaceous age, known as the Desert Sandstone formation, and also in vesicular basalt of later geological age." The geological conditions under which opal occurs in the former is wholly distinct from any previously known opal deposit in the world.

The latter mode of occurrence in a vesicular basalt is analogous of those of Hungary and Mexico, but, so far, Australian deposits of this kind have not been worked commercially.'

The opal is found in matrix of ironstone, of sandstone, and occasionally in pipe-clay, and is roughly classed as boulder opal, sandstone opal, and pipe opal. Practically, every variety of opal is found in Queensland, including the noble opal, the harlequin opal, the fire opal, the pin-fire opal, etc., etc., the miners having many terms of their own indicative of quality and peculiarities, and there is no doubt that the opal of Queensland has excelled in beauty and abundance that of the whole world.

I remember well when very few people would look at Queensland opal, because Hungarian opal was the standard of that time, and now the Hungarian opal is hardly ever heard of, and in the trade is quoted at less than half the price for Queensland opal.

The opal is certainly the most beautiful stone the World has ever seen, and in Pagan times was said to be the residence of the Gods, for being the most beautiful thing on earth, the Gods would naturally take it for a home. Then the modern novelist (Sir Walter Scott) came along and, reviving an old legend, wrote a little fiction which spoilt the old pagan idea and the reputation of the opal at the same time, and the gorgeously beautiful opal was for a time relegated to the limbo of speckled hens, spilt salt, jackdaws, and other omens of ill luck, and this, in



spite of Royal patronage, as it was always a favourite with our late Queen, who invariably chose it for presents to her relatives.

**BLACK OPAL.**—A variety of opal recently discovered is the black opal which has aptly been described by a New Zealand journalist who visited the Exhibition at Christchurch, and saw Messrs Flavelle, Roberts and Sankey's exhibit of Queensland gems, as "it combines the iridescence of the dewdrop, with the color of the rainbow, set in the blackness of night; it is a smothered mass of hidden fire."

**QUARTZ.**—The many varieties of Siliceous gem stones are all found in Queensland, and are very widely distributed.

Quartz crystallises in the hexagonal system, commonly as a six-sided prism, terminated with a six-sided pyramid and striated transversely. These crystals according to color are termed amethyst, cairngorm, rockcrystal, smoky quartz, and are all found at Stanthorpe, Bowen, Anakie, and many other places within the State. For other forms of silicious gem stones found in Queensland see list.

All the crystalline varieties of silica occur in Queensland, but unfortunately they are almost invariably ignored by miners in the search for gold, and so it is difficult to obtain good specimens; some of those obtained have been cut, and produced very fine gems.

**CARNELIAN.**—One of the forms of chalcedony. Carnelian in all its forms, white, red, carnelian-agate, etc., are found from Humpybong to Cunningham's Gap, from Mt. Lindsay to Cape York.

**SARD** is the very clear orange to vermillion carnelian, and is largely used for gentlemen's signet rings. When banded with white it is sardonýx, and is usually cut, showing two strata of the stone.

**AGATE.**—In all its forms of banded agate, fortification-agate, carnelian agate, moss agate, eye agate, etc., etc., is found throughout the State, as indicated by the vast number of "Agate Creeks" in Queensland, and thousands of tons of the stones are obtainable.

They all consist of crypto-crystalline silica, with coloring oxides, and generally with centres of crystalline quartz.

**THE CHALCEDONY** of Jewellers is a pale variety, it is the "patra dura" which the Italians use for the stone cameos.

**CHRYSOPRASE.**—Of rich apple green colour, is found in the Logan and Yaamba districts, also about Springsure. This stone, which until recently, was only procured from one locality in Bohemia, is said to ensure good luck, and was formerly used for green and white cameos, it is far superior in richness and colour to the New Zealand green-stone.

It owes its peculiar soft hue to nickel oxide.

**AMETHYST.**—Crystals of amethyst are found in many districts in this State, including Stanthorpe, Kilkivan, the Burnett, Bowen, Anakie and Herberton; they are simply quartz crystals coloured purple; they are very beautiful, and those of good rich colour, clear and free of flaws, have considerable value.

The amethyst is another of the ecclesiastical gem stones, and is even now worn by nearly all bishops.

In ancient times it was valued on account of its mystical properties and as an antidote to drunkenness.

**THE CAIRNGORM** is another of the varieties of quartz crystal, it ranges from yellow to deep brown, and is found practically throughout the State.

**JASPER.**—Is found on the Gympie goldfield, Stanthorpe, Oxley, and other districts.

**MOSS AGATE.**—Found on the Burnett Water-shed, at Stanthorpe, and many other places; in appearance it is as though moss had been imprisoned in the clear stone.

**MORION.**—A variety of banded smoky quartz crystal; is very handsome, and found on many of our gold and tin fields.

**ROSE QUARTZ.**—Quartz of rosy hue is frequently found in the State.

**SAGENITE.**—Sagenitic quartz, sometimes called grass stone by the miners on account of its appearance, which is peculiar owing to the inclusion of asbestos fibres in the crystals; on some of the fields these grass-stones have considerable local value.

This stone was formerly known as the Venus' hair stone, and also as Cupid's arrows, Marmor's hair, etc.

All the other varieties of quartz stones, including aventurine, bloodstone, cat's eye, citrine, hyacinth, plasma, prase, rock crystal, sardonyx, etc., are found widely distributed throughout Queensland.

**EMERALD.**—Composition : Silica.

Alumina.

Glucina

Hardness, between 7.5 and 8.

S.G., 2.7, about.

Form, regular six-sided prism.

The prism is often striated both internally and externally, parallel with its sides. Emeralds have been found near Herberton, and a further find has been reported in the far North West, exact locality unknown. The crystals shown in the collection are from Emmaville.

**BERYL.**—Is found in several places in this State. The crystals exhibited are from near Texas. It is often found in the tin wash about Stanthorpe, and near Herberton.

**TURQUOISE.**—Has been found at Keppel Bay, and also in one or two other places in the State. Stones exhibited are green turquoise in matrix, colour being a very pleasant, rich green. No deep sinking has been done on this find of turquoise, and it is fully anticipated that the quality will improve as they go down.

**TOPAZ.**—Crystals are prisms usually having one end regularly terminated.

Basalt cleavage highly perfect, Refraction strong. The topaz occurs in many different districts in Queensland, has been found close to Brisbane, Toowoomba, Stanthorpe, Boonah, Mount Lindsay, Kilkivan, Nanango, Herberton, and many other places. It is found of pure limpidity, both as crystals and pebbles, also of different shades of yellow and many shades of light blue. Some of the blues found have been almost like pale blue sapphires. My firm has cut a magnificent and flawless stone, of 78 carats, for Mrs. Skertchly, which is probably the largest blue topaz found since the beginning of the last century.

The white topaz, when brilliant cut, can easily be mistaken for the diamond, the only difference being that the diamond is iridescent.

**LAPIS LAZULI.**—Has been found near Herberton. It will be well-known as the chief constituent of the genuine ultramarine, once so much used by artists.

**MOONSTONE.**—The moonstone is invariably associated in the minds of Australians with Ceylon, as the whole of the moonstones sent here are from Ceylon.

Moonstones have been found in Queensland, near Nanango. Moonstones are the milky and transparent varieties of several species of felspar, remarkable for the pearly reflection of light. They are generally looked upon as lucky stones by the natives of India.

The hardness is about 6, specific gravity about 2.6; composition is silicates of alumina with silicates of alkali and silicates of lime.

The colours of gem stones in Queensland are quite a revelation to the popular mind, and in order to show the wonderful range of colour which our gem stones possess, I attach the following list of stones arranged under different colour headings. By these it will be seen that the sapphire, which popularly is a blue stone, is in this State found of every hue of blue, green, yellow and orange.

I also exhibit a colour star diagram of Queensland gems, which proves that practically every colour and every shade and tone of colour is represented by the gems of this State.

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# COLOURS OF GEMS

## LIMPID or COLOURLESS

Zircon (*Jargoon*). Sapphire. Spinel. Diamond.  
Tourmaline. Beryl. Quartz (*Rock Crystal*).

## YELLOW

Zircon (*Jacinth*). Sapphire (*Oriental Topaz*). Garnet  
(*Essonite* or *Cinnamon Stone*, *Topaxolite* or *Grossularite*).  
Chrysoberyl (*Oriental Chrysolite*). Spinel. Topaz. Diamond.  
Olivine (*Chrysolite*). Tourmaline. Beryl. Quartz (*Citrine* or  
*Scotch*, *Spanish*, *Saxon* or *False Topaz*).

## BROWN

Zircon (*Jacinth*). Sapphire (*Adamantine Spar*).  
Garnet (*Essonite* or *Cinnamon Stone*). Diamond.  
Tourmaline. Quartz (*Cairngorm*).



### GREEN

Zircon. Sapphire (*Oriental Emerald & Peridot*).  
Garnet (*Demantoid, Ouvarovite*). Chrysoberyl.  
(*Alexandrite*). Spinel. Topaz. Diamond.  
Olivine (*Peridot*). Tourmaline (*Brazilian Emerald*).  
Beryl (*Emerald, Aquamarine*). Quartz (*Chrysoprase*.  
*Plasma, Frase. Jasper*). Turquoise.

### BLUE

Sapphire. Spinel. Topaz. Diamond.  
Tourmaline (*Indicolite*). Beryl (*Aquamarine*).  
Iolite (*Water Sapphire, Dichroite*).

### VIOLET

Sapphire (*Oriental Amethyst*). Garnet. Spinel.  
Diamond. Tourmaline. Quartz (*Amethyst*).





## RED

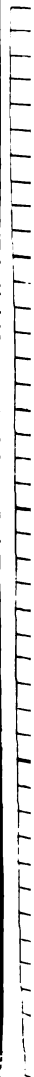
Zircon (*Hyacinth*). Ruby. Garnet (*Pyrope*,  
*Rhodolite*, *Almandite*, *Essonite*, [*Carbuncle*]). Spinel  
(*Balas Ruby*, *Rubicelle*, *Spinel Ruby*). Diamond.  
Tourmaline (*Rubellite*).

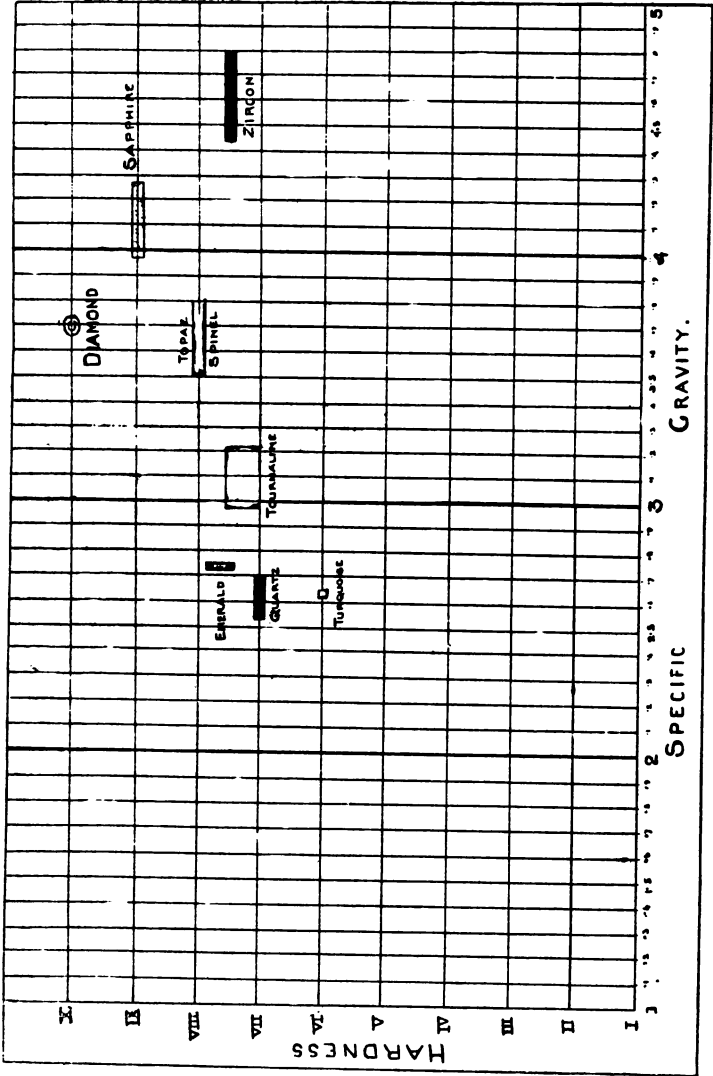
## PINK

Sapphire (*Ruby*). Garnet (*Grossularite*).  
Chrysoberyl. Spinel (*Rubicelle*). Topaz.  
Diamond. Tourmaline (*Rubellite*). Beryl.

## ORANGE

Zircon (*Jacinth*). Sapphire (*Oriental Topaz*).  
Garnet (*Spessarite*, *Essonite*). Chrysoberyl.  
Spinel (*Rubicelle*). Topaz. Diamond. Tourmaline.







## PROCEEDINGS

OF THE

# Annual Meeting of Members,

*Held on Saturday, January 26th, 1907.*

The Annual Meeting of Members was held at the Technical College, Ann Street, on Saturday, January 26th, 1907.

Hon. A. Norton occupied the chair until the arrival of the Vice-President, Dr. A. J. Turner.

The Chairman tendered an apology for the absence of the President, who was then in Melbourne.

Minutes of last Annual Meeting were read and confirmed.

The Report of Council and Financial Statement for 1906 were read, and, on the motion of Mr. J. Brownlie Henderson, seconded by Mr. R. Cliffe Mackie, were adopted.

*To the Members of the Royal Society of Queensland.*

The Council of the Royal Society of Queensland have pleasure in presenting their Annual Report, which deals with the work of the Society during 1906.

Forty-four new Members have been elected during the year, and the Membership now stands at 115.

The following is a list of the new Members:—

Wm. Collins, Dr. A. Sutton, Walter C. Gregory, Chas. W. Costin, Wm. B. Slade, Eric W. McConnel, Geo. Fox, M.L.A., Gerard R. Gore, James H. McConnel, Hon. Angus Gibson, M.L.C., Hon. E. D. Miles, M.L.C., Wm. Hood, C. W. Bundock, D. MacTaggart, Hon. G. W. Gray, M.L.C., Hon. T. B. Cribb, T. W. Millar, Hon. E. B. Forrest, M.L.A., P. J. Leahy, M.L.A., John Leahy, M.L.A., Major D. E. Reid, Edward J. McConnel, Rev. E. C. Ganley, A. Raymond Jones, John Forrest, Hon. E. H. T. Plant, M.L.C., Hon. F. I. Power, M.L.C.,

Robert S. Archer, W. M. Nelson, Sir Pope A. Cooper, C.J., Mrs. Murray Prior (Marroon), Miss Collins (Mundoolan), G. K. Seabrook, H. M. Chapman, Dr. J. P. Ryan, J. G. Collins, W. J. Young, C. E. Bright, E. G. Scriven, Robt. M. Collins, Edward O. Marks, Mrs. Hogarth (Kerriellaw), W. V. Ralston, Frank Smith, B.Sc.

**MEETINGS.**—Eight ordinary Meetings were held during the year, when the following papers were read:—

January 27th.—“Symbranchiate and Apodal Fishes New to Australia,” *J. D. Ogilby.*

March 5th.—“Mistletoe,” *J. Shirley, B.Sc.*

“Lepidoptera Feeding on Mistletoe,” *R. Illidge.*

“Notes on Four Fish Exhibits,” *J. D. Ogilby.*

April 2nd.—“A New Tree Frog from Brisbane,” *J. D. Ogilby.*

“The Pediculate Fishes of Queensland,”  
*J. D. Ogilby.*

“Canada, West to East,” *Geo. Watkins.*

May 25th.—“Queensland Forestry,” *J. Shirley, B.Sc.*

August 3rd.—“Random Notes on Australian Snakes,”  
*Hon. A. Norton, M.L.C.*

August 31st.—“On a New Therapon from the Freshwater of Queensland,” *J. D. Ogilby.*

“The Influence of Physical Agents on Micro-organisms,” *C. J. Pound.*

October 4th.—“Mental Development in Animals,” *Hon. A. Norton, M.L.C.*

October 21st.—“On a Supposed New Form of Hyaline Daphnia,” *W. R. Coddge.*

December 22nd.—“Queensland Gems,” *Major J. R. Sankey.*

An interim Meeting was also held on May 5th, at which Hon. A. Norton and Mr. W. J. Byram exhibited a series of lantern views of Queensland northern scenery.

Thirteen Council Meetings were held during the year, the attendances being as follows:—B. Dunstan, 5; Dr. A. J. Turner, 8; Hon. A. Norton, M.L.C., 11; R. Illidge, 11; J. F. Bailey, 11; W. J. Byram, 10; J. Cameron, M.L.A., 3; Dr. J. Thomson, 6; J. Shirley, 8; F. E. Connah (*Hon. Sec.*), 12.

In October Mr. Cameron was granted leave of absence for the remainder of the term, owing to ill health.

Vol. XIX., Part 2 of the proceedings was completed in April, and copies forwarded to Members and exchanging Societies.

An index to Vol. XIX. is in course of preparation and will be sent out with the next volume published.

Donations from kindred Societies and from other sources during the year have added considerably to the value of the Library, and it is to be regretted that owing to so much matter remaining unbound through lack of funds, the Library has not been available to Members to the extent desired.

Until a way can be found to have some binding done, the state of the Library cannot be considered satisfactory.

In March a deputation waited on the Chief Secretary to urge the renewal of the Government endowment, but without success.

During the year a Collector was appointed for back subscriptions, and these have now been considerably reduced.

The financial statement, as usual, is presented separately, and it will be seen that we start the new year with a credit balance of £22 5s. 11d., with very few outstanding accounts.

Signed on behalf of the Council,

FRANK E. CONNAH,

*Hon. Secretary*

B. DUNSTAN,

*President.*

Brisbane, January 26th, 1907.



# THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT for the Year ending December 31st, 1906.

Dr.

Cr.

RECEIPTS.	£	s.	d.	DISBURSEMENTS.	£	s.	d.
To Balance from last report ..	..	12	8	By Rent of Rooms ..	..	0	0
" Subscriptions and Donations ..	..	91	7	" Printing and Stationery ..	..	38	8
" Nature Study Exhibition ..	..	1	12	" Postage and Petty Cash ..	..	7	19
" Contributions to Printing ..	..	5	17	" International Catalogue ..	..	16	3
" Sale of Proceedings ..	..	0	8	" Nature Study Exhibition ..	..	3	11
				" Commission to Collector ..	..	3	17
				" Insurance on Library ..	..	1	2
				" Advertising ..	..	4	6
				" Bank Charge ..	..	0	10
				" Cheque Book ..	..	0	2
				" Typing ..	..	0	11
				" British Science Guild ..	..	0	5
				" Sundry Expenses ..	..	0	10
				" Balance December 31st, 1906 ..	£33	17	7
				Per Bank Book ..	..	12	0
				Less Unpresented Cheque ..	..	0	0
					21	17	7
				Cheque in hand ..	..	0	8
				Petty Cash in hand ..	..	0	4
					£22	5	11
					£111	13	1

Liabilities—Pole & Co. (Printing), 5s. 6d.; Advertising, 9s.; Total, 14s. 6d.

A. NORTON, Hon. Treasurer.

GEO. WATKINS, Hon. Auditor.

Brisbane, 21st January, 1907.

Examined and found correct.

The following office-bearers for 1907 were then elected : *President*, A. Jefferis Turner, M.D. ; *Vice-President*, J. C. Brunnich, F.I.C. ; *Hon. Treasurer*, Hon. A. Norton, M.L.C. ; *Hon. Librarian*, Frank Smith, B. Sc. ; *Members of Council*, J. F. Bailey, W. J. Byram, J. Brownlie Henderson, F.I.C. ; J. Shirley, B. Sc. ; F. E. Connah ; *Hon. Auditor*, Geo. Watkins ; *Hon. Lanternist*, A. G. Jackson. Mr. F. E. Connah consented to act as *Hon. Secretary (pro tem.)*, there being no nomination for the position.

A vote of thanks to the retiring President, Hon. Secretary and Hon. Librarian, were carried by acclamation. Mr. J. Brownlie Henderson urged that the Society should support the movement for the establishment of a University in Queensland. The matter was left in the hands of the Council.

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END OF VOLUME XX.





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PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND.

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VOLUME XXI.

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THE  
**Royal Society of Queensland.**

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**Patron :**  
HIS EXCELLENCY LORD CHELMSFORD.

---

**OFFICERS, 1908.**

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**President :**  
J. C. BRUNNICH, Esq., F.I.C.

---

**Vice-President :**  
J. F. BAILEY, Esq.

---

**Hon. Treasurer :**  
HON. A. NORTON, M.L.C.

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**Hon. Secretary :**  
H. M. CHALLINOR.

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**Hon. Librarian :**  
FRANK SMITH, B.Sc.

---

**Members of Council :**  
COLONEL JOHN THOMSON, M.B., P.M.O.  
DR. ALFRED SUTTON:      W. J. BYRAM,  
J. SHIRLEY, B.Sc.      J. BROWNLIE HENDERSON, F.I.C

---

**Trustees :**  
JOHN CAMERON, M.L.A.      HON. A. NORTON, M.L.C.  
COL. JOHN THOMSON, M.B.

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**Hon. Auditor :**  
GEO. WATKINS.

---

**Hon. Lanternist :**  
A. G. JACKSON.

# CONTENTS.

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<b>NEW GENERA AND SPECIES OF FISHES.—</b>	
<i>J. D. Ogilby, March 23rd, 1907</i> ... ..	1
<b>THE GEOLOGY OF THE GLASSHOUSE MOUNTAINS.—</b>	
<i>J. Shirley, April 27th, 1907...</i> ...	27
<b>GRAPHICAL AND MECHANICAL AIDS TO CALCULATION.—</b>	
<i>J. C. Brunnich, May 25th, 1907</i>	33
<b>AN EFFICIENT AUTOMATIC SAND FILTER.—</b>	
<i>H. Wasteneys, June 27th, 1907</i> ... ..	45
<b>A NEW TEST FOR MERCURY.—</b>	
<i>P. W. Jones, June 27th, 1907</i> ... ..	49
<b>THE DETECTION OF MERCURY IN EXPLOSIVES.—</b>	
<i>J. B. Henderson, June 27th, 1907</i> ...	51
<b>THE BUILDING OF AUSTRALIA, DEALING WITH THE ORIGIN OF OUR CLIMATE, FAUNA, FLORA, AND WATER SUPPLY.—</b>	
<i>Professor S. J. B. Skertchly, December 14th, 1907</i> ... ..	57
<b>NEW GENERA AND SPECIES OF QUEENSLAND FISHES.—</b>	
<i>J. D. Ogilby, December 14th, 1907</i> ... ..	87
<b>INSECTS AND DISEASES (PRESIDENTIAL ADDRESS).</b>	
<i>—Dr. A. Jefferis Turner, January 27th, 1908</i> ...	99

# ON NEW GENERA AND SPECIES OF FISHES.

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**By J. DOUGLAS OGILBY.**

---

*Read before the Royal Society of Queensland,  
March 23rd, 1907.*

---

AN analysis of the following paper shows that it deals in one way or another with 38 species of fishes, all but two of which belong to Queensland. The addition of these 36 species to the fauna of the State is due to the enterprise and acumen of the members of the Amateur Fishermen's Association of Queensland, and of those friends, equally of both sexes, who, though as yet, unfortunately, not members, have spared neither time nor trouble in collecting and forwarding objects of interest. The fact that such an addition has been made to our fauna during the short space of twelve months through the medium of a comparatively small and struggling Association, calls attention to some points of profound interest to all those to whom the future welfare of our great State is a matter of thoughtful study. Primarily it emphasizes the magnitude of the work which still remains to be done in elucidating the problems connected with the marine zoology of the State; and it has to be remembered that with this elucidation is intimately connected an industry, which, being unaffected either by drought or flood, is more stable and permanent than either pastoral or mining pursuits—which Nature brings in profuse abundance to our very doors—which recuperates itself for the heavy annual toll which we take from it without the cost of a penny piece to the community—and which, though now small and neglected, cannot fail in time to be one of the most reliable as well as the most valuable assets of the State. Secondly it proves the utility of this and kindred Associations, so long as they keep ever in view that the primal reason of their existence is to encourage the preservation of our fishes, and to foster the development of our fisheries; these two objects can only be successfully accomplished

by increasingly protecting the nurseries of our food-fishes from the onslaughts of ignorance and greed. Finally, it demonstrates in no uncertain way that this Association is worthy of a more intelligent support, both financial and sympathetic, from Parliament and the public, since the work is done in the common interest of all, without reward, save in the consciousness of worthy work worthily performed.

All the fishes referred to in this paper, whether types or otherwise, are in the collection of the Amateur Fishermen's Association of Queensland.

The general results attained in this paper may be most advantageously shown by dividing the analysis referred to above into different sections as follow :—

a. Proposed new genera (4).

**BRACHÆLURUS** ; fam. *Orectolobidæ* ; type, *B. colcloughi* Ogilby ; v. infra.

**CIRREISCYLLIUM** ; fam. ead. ; type, *Chiloscyllium modestum* Gunther, Proc. Zool. Soc., 1871, p. 654, pl. LIV : Queensland.

**PTENONOTUS** ; fam. *Exocætidæ* ; type, *Exocætus cirriger*\* Peters, Mon. Akad. Berlin, 1877, p. 555, pl.—fig. 1 : China.

**MEROGYMNUS** ; fam. *Opistognathidæ* ; type, *M. eximius* Ogilby ; v. infra.

b. Proposed new species (11).

1. **HETERODONTUS BONÆ-SPEI** ; fam. *Heterodontidæ* ; Table Bay, S. Africa.

2. **BRACHÆLURUS COLCLOUGHI** ; fam. *Scyliorhinidæ* ; Moreton Bay.

3. **DASYATIS FLUVIORUM** ; fam. *Dasyatidæ* ; Brisbane River.

4. **EXONAUTES FULVIPES** ; fam. *Exocætidæ* ; Lord Howe Island.

5. **TRACHINOTUS VELOX** ; fam. *Carangidæ* ; Moreton Bay.

6. **APOGONICHTHYS NEBULOSUS** ; fam. *Apogonidæ* ; Brisbane River.

7. **HYPOPLECTRODES JAMESONI** ; fam. *Serranidæ* ; Moreton Bay.

8. **PARAPLESIOPS POWERI** ; fam. ead. ; Moreton Bay.

---

\* This species has so far been recorded from the China Sea only.

9. *MEROGYMNUS EXIMIUS* ; fam. *Opistognathidæ* ; Snapper Grounds off Moreton Bay.
10. *PSEUDUPENEUS JEFFI* ; fam. *Mullidæ* ; Brisbane River.
11. *SPHEROIDES PERLEVIS* ; fam. *Tetraodontidæ* ; Moreton Bay.

## ORECTOLOBIDÆ.

### BRACHÆLURUS *gen. nov.*

Form rather short and stout, the distal region of the tail scarcely elevated above the dorsal plane. Head moderate and but little depressed, with rather short, broadly rounded snout. Nasal valve folded, with a prominent cirrus. Mouth inferior, transverse, of moderate size, nearer to the eye than to the tip of the snout, with well developed labial grooves, which are not continuous across the symphysis of the lower jaw, behind which is a conspicuous longitudinal groove. Teeth similar in both jaws, arranged in many series, small, and tricuspid. Eyes small, elongate-oval, with horizontal pupil ; spiracles large, below and behind the eye. Posterior gill-slit largest, rather nearer to the fourth than the remaining pairs are to one another, the three last slits above the base of the pectoral fin. Tail a little longer than the head and trunk. First dorsal fin originating above the base of the ventrals, and subequal in size to the second ; anal fin low, close to the caudal : caudal fin with the upper flap feebly, the lower moderately developed and notched near the tip ; a slight notch between the lobes : pectoral and ventral fins large. Skin covered with minute, smooth, lozenge-shaped scales. Ovoviviparous. *βραχὺς* short ; *ἄλινπος*, a cat).

Small ground sharks from the coast of southern Queensland, forming a connecting link between the oviparous *Hemiscylliinae* and the ovoviviparous *Orectolobinae*. Type *Brachælurus colcloughi*. (v. infra, p. 4).

Waite's family *Hemiscylliidae*, characterized "mainly by having the anal fin behind the second dorsal and in being ovoviviparous"\* will have to lapse, owing to my announcement of the oviparity of *Chiloscyllium*†, which necessitates a rearrangement of the scyllioid sharks, of

---

\* Waite, Rec. Austr. Mus., iv, 1901, pt. i, p. 32.

† Ogilby, Proc. Roy. Soc. Queensl., xx, 1906, p. 27.

which I am only prepared to acknowledge two families, the *Scyliorhinidae* with 5 genera and the *Orectolobidae* with 9 genera.

It also necessitates the formation of a second new genus for the reception of Günther's *Chiloscyllium modestum*—the very species on which Mr. Waite relied for the foundation of his family—but which is not strictly congeneric with *Brachaelurus* and necessarily much less so with *Hemiscyllium*.

#### CIRRISCYLLIUM *gen. nov.*

Differs from *Brachaelurus* in the larger, wider, and strongly depressed head; in the anterior position of the mouth, which is well in advance of the middle of the eye; in the ovate spiracles, which are only partly behind the eye; in the more posterior insertion of the anal fin, which is approximate to and far overlaps the caudal; and in the much larger scales. (*cirrus*, a lock of hair, here signifying a "tentacle"; *Scyllium*, an allied genus = *Scyliorhinus*: in allusion to the great development of the nasal cirrus in comparison with that of the *Hemiscylliinae*).

Type—*Chiloscyllium modestum* Günther.

Coasts of Queensland and New South Wales.

#### BRACHÆLURUS COLCLOUGHI *sp. nov.*

Body robust, its depth  $7\frac{1}{2}$  in the total length. Width of head equaling its depth and  $\frac{3}{4}$  of its length, which is rather less than  $\frac{3}{4}$  of the trunk and  $5\frac{1}{2}$  in the total length; upper profile of head evenly rounded; preoral length  $\frac{1}{2}$  of that of the head. Anterior angle of nostril equidistant from the mouth and the tip of the snout; internasal width about equaling the preoral length and  $\frac{2}{3}$  of the width of the mouth; nasal cirrus  $\frac{2}{3}$  of the preoral length, not extending to the lower labial groove, and  $1\frac{1}{2}$  time the diameter of the eye in length. Mouth much nearer to the eye than to the tip of the snout, its width  $2\frac{1}{2}$ , that between the outer angles of the labial grooves  $2\frac{3}{4}$  in the length of the head. Eye somewhat nearer to the tip of the snout than to the first gill-slit, its longitudinal diameter  $6\frac{1}{2}$  in the length of the head. Interorbital region flat with a slight median groove, its width  $2\frac{1}{2}$  in the head. Spiracle subvertical, situated in a deep ovate rimmed pit, its diameter  $\frac{2}{3}$  of that of the eye. Branchial region  $2\frac{2}{3}$  times the diameter of the eye; width

of first gill-slit  $\frac{3}{8}$  of the diameter of the eye and  $\frac{5}{8}$  of that of the last slit. Length of head and trunk  $\frac{4}{5}$  of that of the tail. First dorsal fin originating above the middle of the base of the ventral, its distance from the tip of the snout  $2\frac{1}{4}$  in the total length; anterior and outer borders of fin sublinear, the intervening angle broadly rounded; posterior angle pointed, the hinder border proximally emarginate, its length  $1\frac{1}{2}$  time the diameter of the eye and rather more than  $\frac{1}{2}$  of its basal length, which is  $1\frac{1}{2}$  time the vertical height of the fin: second dorsal similar to but not quite so large as the first, its distance from the origin of which is  $1\frac{1}{4}$  in that from the tip of the tail. Distance between origin of anal and second dorsal less than the interval between the dorsals and  $4\frac{1}{2}$  in its distance from the ventrals; its height is  $2\frac{1}{2}$  in its base; free space between anal and caudal  $1\frac{1}{2}$  in the base of the anal. Depth of lower caudal lobe  $6\frac{1}{2}$  in its length, which is  $4\frac{1}{2}$  in the total length, its extremity rounded; tip of vertebral column not nearly reaching the margin of the fin. Pectoral fin obovate, its distance from the ventral  $\frac{3}{8}$  of that from the tip of the snout, its base rather more than  $\frac{1}{2}$  of its greatest width and rather less than  $\frac{1}{2}$  of its length, which is  $\frac{5}{8}$  of that of the head. Origin of ventral fin a little nearer to the first dorsal than to the pectoral. A slight but distinct vertebral groove between the occiput and the first dorsal; lateral line strongly marked forming a ridge, connected by a transverse line above the spiracles. Upper surfaces, sides, and tail ashy gray; lower surface of head, throat, and abdomen white. (Named for my friend Mr. John Colclough, late of Brisbane, and now holding a responsible position in the Aru Islands).

Total length of type 460 millimeters.

Coast of Queensland.

Type in the collection of the Amateur Fishermen's Association of Queensland.

Described from an immature male caught at Mud Island, Moreton Bay, on June 8th, 1906, by Mr. F. L. Phillips, and presented by him to the above collection. Cat. No. 410.

There is a second specimen of about the same size in the State Museum.



## DASYATIDÆ.

DASYATIS FLUVIORUM *sp. nov.*

Disk subcircular, its length  $\frac{2}{3}$  of its width. Anterior borders of disk linear, meeting one another at a widely obtuse angle; posterior borders rather feebly, inner moderately convex; outer angles broadly, posterior somewhat narrowly rounded. Outer border of ventral fin nearly straight, as long as the snout; hinder border feebly convex, meeting the outer at rather less than a right angle, the point rounded; inner angle rounded. Width of mouth subequal to the space between the anterior angles of the nostrils. Snout slightly projecting beyond the anterior contour. Free border of nasal flap minutely fringed. Lower lip corrugated. Diameter of eye  $2\frac{1}{2}$  in the width of the interorbital region, which is rather more than that of the mouth and  $\frac{1}{3}$  of the length of the disk. Jaws undulated, the upper biemarginate, the intervening ridge fitting into the mesial emargination of the lower jaw, which is strongly bent backwards laterally, so that its entire posterior border is emarginate. Upper jaw succeeded by a wide, fimbriated, membranous flap, bearing on its free border 30 cilia. Floor of mouth with 7 papillæ arranged in three groups; on each side a pair, of which the inner is the longer, the outer sometimes absent or vestigial, and three in the middle, these being more conspicuous and truncated. No rostral groove; frontal region with a wide shallow tongue-shaped median depression, which is separated by a narrow bridge from a much smaller circular occipital depression. A row of small, open, mucigerous papillæ, mostly associated in pairs or threes, between the tip of the snout and the frontal depression, immediately in advance of which they form a small cluster; each preorbital region with a much larger group of similar papillæ, which extends backwards above and below the eye and is united to the rostral system by an oblique series of single pores; a small, irregular cluster outside of and partly anterior to the preorbital group; a semicircular series on either side of and a pair, placed transversely, within the occipital depression; a crescentic biserial band of subcutaneous tubular pores below and well outside the eye; a similarly situated oval cluster below

the spiracles. A group of small blunt tubercles above each spiracle, from which a more or less extended series curves forward along the supraciliary edge; a transverse row of three tubercles behind the occipital depression, from behind the middle one of which a series of retrorse spines extends along the dorsal ridge and is continued on the tail nearly to the base of the caudal spine; one of the median interscapular spines is slightly larger than the others of the vertebral series; entire scapular region tuberculigerous, the central group quinquerradiate, one branch directed forwards along and converging on the axial series, two directed outwards to a level with the spiracle, and two directed backwards, but somewhat divergent from the axis; on either side between the basal angles of the outer and hinder branches are two or three enlarged tubercles. Length of tail  $2\frac{1}{2}$  times that of the disk; spinous tubercles of tail, especially the four nearest to the caudal spine, larger than those of the dorsal ridge; sides of tail with a few scattered prickles; proximal portion of caudal spine laterally granulated, the rest, with the exception of the extreme tip, which is smooth, armed with fine, closely set serræ; length of spine  $\frac{2}{3}$  of that of the prespinous portion of the tail, which is  $5\frac{1}{2}$  in the length of the tail. A short fold, highest posteriorly, on the upper surface of the tail, overlapped in front by the caudal spine; lower surface of tail with a much longer and slightly higher fold, which originates below the base of the caudal spine. Olive-brown above, the margins of the disk and the ventral fins lighter; below bluish white with the discal borders pale brown; tail black, the lower surface and sides of the proximal fourth brown; spine and tubercles whitish (*fluviorum*, of the rivers).

*Measurements of type in millimeters.*

Length from tip of snout to end of anus 250; width of disk 275; length of ventral fin along outer border 60; width of mouth 27; between outer anterior angles of nostrils 28; diameter of eye  $10\frac{1}{2}$ ; width of interorbital region 30; length of tail 544.

Brisbane River, ascending well above the tideway.

This species is distinguished from *Dasyatis gymnura* (Müller)\* by the shape of the snout, which in that species is "produced and sharp-pointed"; by the convexity of the posterior border of the disk; by the much shorter tail, which in *gymnura* is thrice the length of the disk; and by its general smoothness. In some respects it approaches *Dasyatis sabina* (Le Sueur), which is, like it, a strictly estuarine and fluviatile species.

## EXOCETIDÆ.

### EXONAUTES FULVIPES *sp. nov.*

D. 12; A. 12; Sc. 52—7. Depth of body 6, length of head  $4\frac{1}{2}$  in the length of the body. Head a little wider than deep, its width equaling its length in front of the hinder margin of the eye. Snout  $\frac{1}{3}$  of the diameter of the eye, which is  $2\frac{1}{2}$  in the length of the head,  $\frac{2}{3}$  of the postorbital region, and equal to the concave interorbital width. Gill-rakers 19 on the lower branch of the anterior arch, the last 3 tubercular, the longest  $\frac{1}{3}$  of the diameter of the eye. Second pair of upper pharyngeal bones separate, armed with slender, conical, setaceous teeth; third pair fused, forming together a half-moon-shaped bone, which is densely clothed mesially with coarse scalpriform teeth, laterally with much smaller tricuspid teeth; lower pharyngeals united to form a sagittate bone, armed with small tricuspid teeth and a few somewhat enlarged and scalpriform teeth posteriorly.† Dorsal fin moderately high, its second and highest ray  $\frac{1}{2}$ , its basal length  $\frac{1}{4}$  of the length of the head: anal originating below the 2nd. ray of the dorsal, which also slightly overlaps it, its length  $\frac{2}{3}$  of the head: upper

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\* *Trygon gymnura* Müller, in Ermann, Reise um die Erde, p. 25, pl. xiii, 1830, is identical with *T. tuberculata* (not Bonnaterre 1788) Shaw, Gen. Zool., v, p. 290, 1804 (after Lacépède's Raie tuberculée) and Günther, Catal. Fish., viii, p. 480, 1870. The latter author records it from Sydney, confounding it with one of our eastern species, possibly my *D. thetidis*. (Mem. Austr. Mus., no. iv. pt. i, p. 46, 1899).

† There is abundant evidence to show that all the teeth were originally tricuspid, those which are now apparently chisel-shaped having had the cusps worn down by continuous trituration.

caudal lobe acutely, lower bluntly pointed, the latter  $3\frac{1}{2}$  in the length of the body: two upper pectoral rays simple; 1st. ray  $\frac{2}{3}$  of the 2nd, and  $\frac{2}{3}$  of the 4th and longest ray; 2nd. ray  $\frac{2}{3}$  of the 3rd, and  $\frac{2}{3}$  of the 4th ray; outer branch of 3rd. ray extending to midway between the tips of the 2nd, and of its own inner branch; 3rd. ray of the 4th, which is  $\frac{2}{3}$  of the length of the body and reaches to the base of the caudal: ventral inserted midway between the root of the caudal and the gill-opening; 3rd. ray longest, not quite reaching to the rudimentary caudal rays and  $\frac{1}{2}$  of the body-length. Above glossy brown, each of the scales with a lighter border; sides of head and body golden brown; belly silvery: all the fins pale yellowish brown (*fulvus*, tawny; *pes*, foot).

Type in the Australian Museum, Sydney.

Total length 310 millimeters.

Seas round Lord Howe Island.

The specimen from which the above description was drawn up has been the subject of more than one examination and identification. Originally referred by me to the Middle American *Exonautes dowii*, Waite, during his visit to Lord Howe Island in December, 1902, having obtained several examples through the agency of certain complaisant nesting gannets, re-examined this specimen and decided that it belonged to the Atlantic\* *E. rondeletii*; from this species, however, it differs among other characters, in its more slender form, longer snout, shorter anal fin (as compared with the dorsal), longer pectorals, posterior insertion, much greater length and uniform coloration of the ventrals. *E. fulvipes* is in fact the Western Pacific representative of the Atlantic *E. rondeletii*, while it is possible that the Eastern Pacific form, as exemplified by the Acapulco specimen, may differ specifically from both. No other known species of *Exonautes*, other than *E. exsiliens* and *E. rondeletii*, can possibly be confounded with

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\* I am aware that Lütken records this species from Acapulco, a seaport on the Pacific Coast of Mexico, but Lütken himself was in considerable doubt as to whether he was not confusing two or more species under the specific name *rondeletii*. "This species is subject to some variation, or else, as Dr. Lütken suggests, we are uncertain as to the number of real species that group themselves around its type." (Jordan & Evermann, Fish. N. & Mid. Amer., pt. i, p. 733, footnote\*).

*E. fulvipes*, since all the others have the second pectoral ray divided.\* *E. exsiliens* may easily be distinguished by the equality in length of the two first pectoral rays and the anterior position of the ventral fins, which are inserted midway between the root of the caudal and the eye.

Described from a fine specimen in the collection of the Australian Museum, Sydney; Reg. No. I. 1955. I have also examined a second specimen (unnumbered and without locality), labeled in Bleeker's handwriting "*Exocætus exsiliens*."†

Under the heading of "*Exocætus unicolor* ? C. V."‡ Kner§ records an exocætid from Sydney; but we know from Bleeker's personal examination of the three examples upon which Valenciennes established his species, and which are part of the collection in the Jardin des Plantes, that this is a hybrid form composed of two specimens of *Cypsilurus* and one of *Exonæutes*.

Bleeker's remarks on the three specimens mentioned by Valenciennes are as follows, and in my opinion form

\* I am unable to speak with certainty regarding *Exocætus ilma* Clarke, as the author's long and rambling description gives but little clue as to its position, and the important characters connected with the upper pectoral rays are entirely omitted. Judging from the similarity of the dorsal and anal fins we believe it to be *Exonæutes*.

† I take this opportunity of publicly thanking the Trustees and Curator of the Australian Museum for their kindness in lending me their valuable collection of flying-fishes.

‡ The following is a translation of Valenciennes' description:—

*L'Exocet aux pectorales unicolôres.*

(*EXOCÆTUS UNICOLOR* nob.)

Another species from the Seas of India—

has the occiput flattened and the snout a little compressed, like that of the Mediterranean (*Exocætus volitans*), but the eye is much larger and the head longer. The length of the head is somewhat less than  $\frac{1}{4}$  of the total length (c.c.). The orbital diameter is  $\frac{1}{3}$  of the length of the head. The dorsal fin is low and nearly equal (in height).

D. 13; A. 11.

The color of the back, like that of the preceding species (*Exocætus speculiger*) is uniform plumbeous; the pectorals are violaceous gray, without either the white spot or border of the preceding species. The ventrals are white, with a small gray longitudinal spot near the axil.

The specimens are a foot long; they have been brought from Vanikoro and Java by MM. Quoy and Gaimard; a third has come to us from the Seas of India by the courtesy of M. Dussumier.

§ Reise Novara, Fisch. p. 325.

the crux of the whole question :—"Formerly I believed that my *oligolepis* was identical with the *unicolor* of Valenciennes, but the examination which I was privileged to make in Paris, of the three examples which served Valenciennes for the establishment of his *unicolor*, has convinced me that not only is *oligolepis* very distinct from it, but also that *unicolor* is founded on three individuals which belong to at least two species, whilst it is not mentioned in the description from which of the three that has been taken. All three specimens have about 50 scales in a longitudinal series, which proves that it cannot rationally be confounded with *oligolepis*. In the individuals from Vanikoro and the Seas of India *the dorsal fin commences well in advance of the anal* and is composed of 13 rays, and I presume that it is from these examples that the description has been taken. These then should constitute the true *unicolor*. As for Valenciennes' third example, which came from Java, it is a very distinct species, with *the dorsal fin originating opposite the first anal ray* and supported by 10 rays only. This individual appears to me to be indistinguishable from *Exocætus oxycephalus* Bleeker, Valenciennes having failed to recognise it as a distinct species."\* The italics in the above paragraph respecting the origin of the dorsal fin are mine.

The above quotation fixes without fear of contradiction the *Exocætus unicolor* of Valenciennes as a *Cypsilurus*, firstly because the dorsal formula of 13 rays given by that author belongs (fide Bleeker) to the two specimens in which "the dorsal fin commences well in advance of the anal," secondly because Bleeker was the earliest author to fix the name *unicolor* on a definite specimen, and thirdly when two of three examples have been proved to belong to a particular genus we would naturally take one of the majority as the type of the species in preference to the single example forming the minority, no type specimen having been designated by the author; and more especially in this case where the arbitrary selection of such a type would wilfully flout the author's own determination as regards the number of the dorsal rays. Valenciennes' species should, therefore, be included in the genus *Cypsilurus*,

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\* Atlas Ichth., vi, p. 70.

taking, for choice, the Vanikoro fish as the type, that being the first specimen referred to by its describer.

In Professor Jordan's recent great work\* this fish is twice referred to as *Exonautes unicolor*, but the above remarks in my opinion clearly prove that this view of its generic position is founded on error. In vol. I, p. 341, an Australian flying-fish is figured with the legend, "Australian Flying-Fish, *Exonautes unicolor* (Valenciennes). Specimen from Tasman Sea, having parasitic lernæan crustaceans, to which parasitic barnacles are attached (After Kellogg)." The second quotation, in vol. II, p. 213, is—"The large Australian species *Exonautes unicolor* belongs to this group." The undivided second pectoral ray in Kellogg's figure certainly suggests that it belongs to the species here described, but the fin formula—D. 10, A. 12—together with the overlapping of the dorsal by the anal, and the extraordinary shape of the latter fin, points to quite a distinct fish; the origin of the anal being distinctly behind that of the dorsal it can not be Valenciennes' Javan fish in which both fins commence on the same plane, and in which the second pectoral ray is divided (equals *Exocætus oxycephalus* Bleeker). Taking all things into consideration, I am inclined to believe that the figure is intended to represent *Exonautes fulvipes*, which, however, can not strictly be called "the large Australian flying-fish," since, so far as is known, the limit of its growth is about one foot, while *Cypsilurus melanocercus*, which inhabits much the same area, and which is the Pacific representative of *Cypsilurus lineatus*, attains a length of eighteen inches.

Before concluding this article there is just one other point to be cleared up, and that is the identity of the Sydney flying-fish referred with a query by Kner to *Exocætus unicolor*. There are several features even in his insufficient description which do not agree with the two specimens on which my diagnosis is founded. For instance, there is one ray less in the dorsal and anal fins, the smaller eye is more than the interorbital width, which is flat, and the pectorals are shorter; while of course we know nothing of the pectoral formula in Kner's fish. Should, however, Kner's fish eventually prove to be identical with that described above,

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\* A Guide to the Study of Fishes by David Starr Jordan, 1905.

which can only be ascertained by a direct comparison of the Sydney fish with my description\*, the specific name *fulvipes* would be superseded by *cribrosus* Kner, an alternative name given by that author to his fish, and in that case the synonymy of the species would stand as follows :—

#### EXONAUTES CRIBROSUS.

*Exocætus unicolor* ? C.V. ; Kner, Reise Novara, Fische p. 325, 1867 : Sydney.

*Exocætus cribrosus* Kner, *ibid.*, p. 326. Suggested new name should the species prove distinct from *E. unicolor*.

*Exocætus dowii* Ogilby, Mem. Austr. Mus., No. 2, Lord Howe Island, p. 71, 1889. Not *E. dowii* Gill, 1863 = *E. rufipinnis* Cuvier & Valenciennes, 1846.

*Exonautes rondeletii* Waite, Rec. Austr. Mus., v, 1904, pp. 156 & 195 : Admiralty Islets. Not *Exocætus rondeletii* Cuvier & Valenciennes, 1846.

*Exonautes unicolor* Jordan, Study of Fishes, i, fig. 226 & ii, p. 213, 1905. Not *Exocætus unicolor* Cuvier & Valenciennes, 1846, which is a *Cypsilurus*.

*Exonautes fulvipes* Ogilby. Supra.

#### PTENONOTUS gen. nov.

This genus is proposed for the accommodation of *Exocætus cirriger* Peters,† and differs from *Cypsilurus* and *Exonautes*, between which it should be placed, in the elongated hemirhamphiform body, the permanency of the submental appendage, which is of great size and divided distally into numerous fine cutaneous filaments, and in the high, pointed dorsal fin, which extends, when depressed, far beyond the base of the caudal. (πτενός, winged; νῶτος, back.)

Hab. China Sea.

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\* If, as I presume, Kner's Novara specimen from Sydney is deposited in the collection of the Imperial Museum, Vienna, Dr. Steindachner might set at rest for ever the identity of *Exonautes cribrosus* by making the suggested comparison.

† Mon. Akad. Berlin, 1877, p. 555.



## CARANGIDÆ.

TRACHINOTUS VELOX *sp. nov.*

D. vi, i 25; A. ii, i 26; Sc. 100 circ. Depth of body  $2\frac{3}{8}$ , length of head  $3\frac{3}{8}$  in the length of the body. Dorsal profile a little more arched than the ventral; profile of head slightly convex from behind the feebly declivous snout to the nape, thence obliquely linear to the origin of the dorsal fin. Snout as long as the diameter of the eye, which is  $3\frac{1}{2}$  in the length of the head; interorbital width rather more than the diameter of the eye. Jaws equal; maxillary reaching to below the anterior border of the pupil, its width at the distal extremity  $\frac{1}{3}$  of the eye. Jaws with a narrow band of villiform teeth, the outer series slightly enlarged; vomer with a triangular patch, palatines each with a short band of similar teeth. Cheeks and upper third of opercles scaly; anterior half of lateral line undulating and slightly descending; posterior half straight. Anterior rays of the dorsal fin extending to the tip of the last ray, of the anal fin to the base of the caudal, the former  $1\frac{6}{7}$ , the latter  $1\frac{3}{8}$  in the length of the body: upper lobe of caudal fin considerably longer than the lower lobe and a little longer than the produced anal rays: pectoral fin just reaching to the vertical from the vent,  $\frac{5}{7}$  of the length of the head: ventral reaching  $\frac{3}{8}$  of its distance from the vent, its length  $\frac{3}{7}$  of the head. Bluish gray above, silvery on the sides and below; a series of from five to seven more or less conspicuous bluish spots above but usually touching and anteriorly sometimes even encroaching upon the lateral line: elongate rays of the dorsal and anal, and the outer rays and tips of the caudal lobes dark leaden blue (*velox*, swift).

Type in the collection of the Amateur Fishermen's Association of Queensland; Cat. No. 289.

By previous writers on Australian zoology this very distinct species has been confounded with the Indian *Trachinotus russellii*, the confusion having doubtless arisen through the similarity of the color markings in the two species. The western fish may, however, be easily distinguished by its deeper body ( $2\frac{1}{4}$  in the length); by the shortness of the dorsal and anal lobes, which do not extend to the end of their respective bases, and of which the dorsal

lobe is the longer; by the much shorter caudal lobes ( $2\frac{1}{2}$  in the length); by the more forward insertion of the ventral fin (below the base of the pectoral); etc. Up to the present we have no authentic knowledge of the occurrence of either *T. russellii* or *T. baillonii*, which are certainly distinct, in the seas of the Commonwealth, and all records of these two species eastward from a line drawn between the West Coast of Australia and the Moluccas must be looked upon with grave suspicion.

Described from a half grown example, caught in the South Passage, Moreton Bay, and presented to the A.F.A.Q. Museum by Mr. Willie J. Howes.

### FAMILY APOGONIDÆ.

#### APOGONICHTHYS NEBULOSUS *sp. nov.*

D. vi, i 9; A. iii 8; Sc. 25 circ.; L. l. 9. Depth of body  $2\frac{3}{8}$ , length of head  $2\frac{3}{8}$  in length of body. Snout  $\frac{1}{2}$  longer than diameter of eye, which is  $\frac{1}{4}$  of length of head. Interorbital region convex, its width  $5\frac{3}{8}$  in the head. Maxillary extending to below middle of eye, the width of its distal extremity  $\frac{5}{8}$  of the eye; lower jaw the longer. Lateral line ceasing below the spinous dorsal. Spinous dorsal originating behind base of pectoral; second spine highest,  $2\frac{1}{4}$  in length of head and not quite so high as the soft dorsal: anal originating slightly behind and somewhat higher than soft dorsal, its basal length  $3\frac{1}{8}$  in the head: caudal rounded,  $3\frac{3}{8}$  in length of body: pectoral  $\frac{2}{3}$  of length of head and as long as the ventral, which reaches to the vent. Pale greenish gray, marbled with olive green; upper surface of head darker; a pair of short, broad, posteriorly convergent, brown bands on the occiput: tips of anal and ventral fins dusky. Irides silvery, strongly suffused with umber brown. (*nebulosus*, clouded).

*Dimensions of type in millimeters.*—Total length to end of middle caudal ray 57; to end of hypural bone 45; depth of body 17.5; length of head 19; of snout 6.25; diameter of eye 4.75; width of interorbital region 3.5; of maxilla 3; height of 2nd dorsal spine 8.5; of soft dorsal 9.5; length of anal 6; height of anal 10; length of caudal 12.5; of pectoral 12; of ventral 12.

Type in the collection of the Amateur Fishermen's Association of Queensland.

Distribution.—Brisbane River. Type locality. Edward Street Baths.

### FAMILY SERRANIDÆ.

#### HYPOPLECTRODES JAMESONI *sp. nov.*

D. x 20 ; A. iii 8 ; Sc. 3— $3\frac{3}{8}$ —14 ; L. l. 40. Depth of body  $2\frac{1}{2}$ , length of head  $2\frac{3}{8}$  in length of body. Snout  $\frac{3}{8}$  longer than diameter of eye, which is  $4\frac{1}{8}$  in length of head. Interorbital region flat, its width about  $\frac{1}{8}$  of length of head. Maxillary extending to below middle of eye, the width of its distal extremity  $\frac{3}{8}$  of the eye ; lower jaw the longer. Preopercle with 3 strong antrorse spines on the lower border ; subopercle denticulated ; upper opercular spine much the longer. Scales of cheeks, opercles, nape, and breast much smaller than those of the body ; lateral line tubes simple, short anteriorly but gradually increasing in length so that posteriorly they extend nearly along the entire scale. Dorsal originating in advance of base of pectoral ; 5th. dorsal spine highest,  $2\frac{3}{8}$  in length of head and a little more than the highest soft rays ; 10th. spine nearly as high as the 2nd,  $\frac{3}{8}$  of highest soft rays : 2nd. anal spine very strong, higher than the 3rd, and than the highest dorsal spine, the rays about as high as the 2nd. spine : caudal truncate,  $4\frac{1}{8}$  in total length : pectoral with 16 rays,  $\frac{3}{4}$  of length of head and longer than the ventral, which just reaches the vent. Dark olive brown above the lateral line, the trunk and tail with about nine narrow gray bands, which are inconspicuous anteriorly ; below the lateral line the gray predominates the dark markings taking the form of seven or eight irregular, transverse, slightly oblique bands, any two of which may be wholly or partially connected, and which only become annular on the tail : sides of head with three longitudinal series of brown spots, the first from below the eye to the preopercular border, whence it curves upwards behind the eye ; the second from the maxilla to the middle of the base of the pectoral ; the third from the angle of the mouth to below the same ; chin blackish ; a black band behind the chin and a pair of similar spots below the corners of the mouth ; opercles

marbled. Spinous dorsal and basal half of soft similar to the back; outer half of soft dorsal and of caudal lighter with a distinct reddish tinge; anal violaceous gray, with two dark basal spots; pectorals strongly, ventrals faintly tinged with red. Irides dark purplish brown. (Named for Mr. Jonathan Thompson Jameson, an enthusiastic collector, who has brought me many interesting zoological specimens.)\*

*Dimensions of type in millimeters.*—Total length to end of middle caudal ray 85; to end of hypural bone 70; depth of body 28; length of head 29; of snout 8.5; diameter of eye 6; width of interorbital region 3.25; of maxilla 5; height of 5th dorsal spine 11; of 2nd anal spine 12.5; length of caudal 15; of pectoral 21; of ventral 18.

*Distribution.*—Moreton Bay. Type locality, Woody Point; other specimens seen from Sandgate.

This very distinct species belongs to the *Gilbertia* group of *Hypoptelectrodes*, and is most nearly related to *H. semicincta*, from which, however, the much larger scales and more strongly developed anal fin at once distinguish it. The pattern of coloration also is widely different from that of the other members of the genus.

#### PARAPLESIOPS POWERI.

D. xii 10; A. iii 10. Sc. 2—33—12; L. 1.  $\frac{3}{4}$ . Depth of body equal to the length of the head, which is  $\frac{1}{3}$  of that of the body. Snout short and rounded,  $\frac{1}{10}$  of the diameter of the eye, which is  $\frac{1}{3}$  of the length of the head. Interorbital region narrow and feebly convex, its width  $5\frac{1}{4}$  in the head. Jaws equal; maxillary extending to below the hinder border of the eye, the width of its distal extremity  $\frac{5}{8}$  of the diameter of the eye. Angle of preopercle with several stout spines. Several series of small scales on the cheeks and postorbital region; opercular scales large. Gill-rakers 12 on the lower branch of the anterior arch. Last dorsal spine the highest,  $1\frac{9}{10}$  in the length of the head and  $2\frac{1}{4}$  in the 6th and highest ray: 3rd anal spine the highest, as high as the last dorsal spine, the 6th soft ray as high

\* I am the more pleased at this opportunity of naming so handsome a species after my friend Mr. Jameson, because it was through my instrumentality that the supposed species named by Macleay *Atherinosoma jamesoni* was reduced to a synonym of *Pseudomugil signifer*.

as the highest dorsal ray and  $2\frac{1}{2}$  in the length of the body, as also is the pointed caudal fin : pectoral with 18 rays, the middle the longest, extending to the vertical from the origin of the anal and a little longer than the head : ventral reaching to the base of the first soft anal ray,  $2\frac{1}{4}$  in the length of the body. Uniform greenish brown, the upper surface and sides of the head with a purplish gloss : all the fins blackish, except the pectorals and basal third of the ventrals, which are pale yellowish brown.

The description is taken from a fine example, 172 millimeters in length, caught at Mud Island, Moreton Bay, by Mr. Percy Power, to whom I have great pleasure in dedicating this handsome and very distinct species, which he kindly presented to the collection of the Amateur Fishermen's Association of Queensland. Cat. No. 224.

### OPISTOGNATHIDÆ.

#### MEROGYMNUS *gen. nov.*

Differs from *Gnathypops* in having the greater part of the trunk naked, the teeth subequal in size, without any conspicuously enlarged series, and the gill-rakers more numerous, longer, and slender (*μέρος*, in part ; *γυμνός*, naked);

East Coast of Australia. Two species.

#### MEROGYMNUS EXIMIUS *sp. nov.*

D. xi 13; A. i 12; Sc. 85 circ.\* Width of body  $7\frac{1}{8}$ , depth of body  $3\frac{1}{4}$ , length of head  $2\frac{2}{10}$  in the length of the body. Width of head  $\frac{3}{4}$  of its depth and  $\frac{5}{8}$  of its length. Length of snout  $\frac{4}{7}$ , interorbital width  $\frac{2}{7}$  of the diameter of the eye, which is  $3\frac{1}{2}$  in the head. Maxillary extending less than a diameter of the eye behind the eye, its length  $\frac{2}{3}$  of that of the head, the width of its distal extremity  $\frac{5}{8}$  of the eye. Jaws with broad bands of small subequal curved teeth; one or two teeth on the vomer. Nasal tentacle minute. Gill-rakers 26 on the lower branch of the anterior arch, the longest  $\frac{1}{2}$  of the snout. Anterior half of the trunk naked, the rest of the body covered with minute scales,

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\* Between the base of the caudal fin and the vertical from the vent, in front of which they are mostly irregular, non-imbricate, and deeply imbedded.

which become increasingly distant and imbedded towards the front; lateral line ceasing below the 5th or 6th dorsal ray. Dorsal fin originating above the middle of the opercle, the length of the spinous portion but little less than that of the soft; height of the last dorsal spine about  $\frac{2}{3}$  of that of the longest (8th or 9th) dorsal ray, which is  $\frac{4}{7}$  of the head: anal originating below or but little behind the commencement of the soft dorsal and about as long as it: caudal long, its length  $\frac{1}{2}$  or rather more, that of the pectoral  $\frac{1}{3}$  of the length of the body: ventral produced, nearly reaching to the vent,  $\frac{3}{4}$  of the length of the head. Golden or golden brown, the sides and lower surface of the tail with two series of large round or oval, golden spots, separated by broad blue interlacing bands; abdominal region and end of tail violet, with splashes of greenish gold: head lilaceous, with irregular violet spots and bars; a deep blue blotch, prolonged upwards as a zig-zag violet band on the opercle; branchiostegal region blackish: outer half of spinous dorsal dark olive green, narrowly bordered above with purple, below with pale blue; the latter band is continued to the end of the soft dorsal, the outer half of which is pale olive green with many of the membranes blue, as also is the base; anal blue, with a median and a basal series of golden spots; caudal rays olive green or purple, the interradiat membrane blue; pectorals pale yellowish brown, the base with one or two vertical blue bars; ventrals bluish black. Iris light blue, with a narrow golden brown rim; pupil dark blue (*eximius*, beautiful).

Type in the collection of the Amateur Fishermen's Association of Queensland; Cat. No. 320. Presented to the Museum by Mr. J. Stitt.

Total length 285 millimeters.

Snapper Banks off Moreton Bay, Queensland.

### FAMILY MULLIDÆ.

#### PSEUDUPENEUS JEFFI *sp. nov.*

D. viii, i 8; A. ii 6; Sc.  $2\frac{1}{2}$ —28+3\*— $6\frac{1}{2}$ . Depth of body  $3\frac{1}{2}$ , length of head  $3\frac{1}{4}$  in length of body. Diameter of eye equal to width of rounded interorbital region and  $\frac{1}{2}$  of snout, which is  $2\frac{1}{2}$  in head and is deeply grooved trans-

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\* On the base of the caudal.

versely above the anterior nostril, from whence the head rises rather abruptly. Teeth stout and conical, in a single series in both jaws. Maxillary extending to midway between anterior nostril and eye, the width of its distal extremity  $\frac{1}{2}$  of the latter; lower jaw included; barbels extending to below posterior border of pupil. Opercular spine conspicuous. Cheek-scales in three series; 2 complete scales between the dorsal fins; tubes of lateral line with from 3 to 5 tubules, mostly on the upper side.\* Spinous dorsal originating above base of pectoral, shorter† but higher than soft dorsal; 3rd spine highest,  $\frac{1}{4}$  of head: middle caudal rays  $\frac{1}{2}$  of the outer, which are  $\frac{1}{3}$  of head; caudal peduncle rather slender, its least depth  $\frac{2}{3}$  of its length and  $\frac{1}{2}$  of that of snout: pectoral with 17 rays, reaching to 11th scale of lateral line, and a little shorter than ventral, which is  $\frac{1}{2}$  of head. Reddish, the median line of the back darker; two broad curved bands on the upper half of the sides greenish yellow; below them a third narrower linear yellow band; these bands extend forwards to the snout and maxillary, the upper passing through the eye and uniting with the dorsal band behind the soft fin, the median terminating at the base of the caudal fin, the lower above the end of the anal; these bands are separated by narrow bars of shining pink; lower surface pearly white; a dark spot on the upper lateral band close behind the eye, and a second at the angle of the preopercle, the two connected by a lighter band; a larger black blotch on each side of the upper half of the caudal peduncle, united above by a broad brown band. Fins red, the proximal half of the rays paler; soft dorsal and caudal narrowly tipped with yellow; base of pectorals dark reddish brown; ventrals with or without a golden submarginal band. Irides fiery orange, clouded above with olive. (Named for Mr. Vincent Henry Jeff, a most generous donor to our Museums).‡

Total length of type to end of middle caudal rays, 121 millimeters.

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\* As is often the case some of the posterior tubes may be simple; in this instance 5 on the right side are simple while all on the left are branched.

† Membrane of terminal spine not included.

‡ Mr. Jeff's numerous and valuable donations, both to the State Museum and to that with which I am specially associated, entitle him to the warmest thanks of all who are interested in our marine zoology.

*Type locality* : Brisbane River.

Jeff's Red Mullet is closely related to *Upeneus signatus*, Günther, but the pattern of coloration is so widely different that I deem it better to call attention to it thus, more especially as Günther's species has never been recorded from this State, nor in fact, further north than the Port Jackson District, where it is common.

Nine species of "red mullets" have up to the present been recorded from the Queensland Coast, but this number will doubtless be largely augmented when our northern waters shall have been more critically exploited, since at least ten other Indo-Malayan forms have already been noticed from British New Guinea, the Solomon Islands, and the New Hebrides, namely :—*Upeneus sulphureus*, *Mulloides ruber*, *Pseudupeneus cherserydrus*, *P. filamentosus*, *P. barberinoides*, *P. indicus*, *P. malabaricus*, *P. bifasciatus*, *P. trifasciatus*, and *P. pleurostigma*.

Our recorded species are as follow :—

- i. UPENEUS Cuvier, Règne Anim., ed. 2, ii, p. 157, 1829 (*vittatus*).

Bands of villiform teeth in both jaws, on the vomer and the palatines.

1. *vittatus* Forskål, Descr. Anim., p. 31, 1775.
2. *tragula* Richardson, Ichth. China & Japan, p. 220, 1846.
3. *roseus* Castelnau, Res. Fish. Austr., p. 11, 1875.
- ii. MULLOIDES Bleeker, Nat. Tijds. Ned. Ind., iii, 1852, p. 697 (*flavolineatus* = *auriflamma*).

Bands of villiform teeth in both jaws ; vomer and palatines toothless.

4. *auriflamma* Forskål, *ibid.*, p. 30.
5. *armatus* de Vis, Proc. Linn. Soc. N. S. Wales, ix, 1884, p. 458 (? *samoensis*).
- iii. PSEUDUPENEUS Bleeker, Mem. Poiss. Cote de Guinée, p. 56, 1862 (*prayensis*).

A single series of stout conical teeth in each jaw ; vomer and palatines toothless.

6. *barberinus* Lacepede, Hist. Nat. Poiss., iii, p. 406, 1802.
7. *rubroniger* de Vis, *ibid.*
8. *jeffi* Ogilby, *ut supra*.
9. *porosus* Cuvier & Valenciennes, Hist. Nat. Poiss., iii, p. 455, 1829.



## FAMILY TETRAODONTIDÆ.

SPHEROIDES PERLEVIS *sp. nov.*

D. 8; A. 6; P. 16. Body robust, evenly tapering from behind the eye, its depth  $3\frac{1}{2}$ , length of head 3 in length of body. Width of head  $1\frac{1}{2}$ , depth of head 1' in its length. Eye moderate, free below, its diameter  $2\frac{1}{2}$  in length of snout and  $4\frac{1}{2}$  in that of head. Interorbital region feebly convex, its width  $7\frac{1}{2}$  (including eyelids  $2\frac{1}{2}$ ) in the head. Lips equal, papillose within; lower jaw included; chin prominent. Teeth with slightly uneven edges and well marked sutural grooves. Width of gill-opening  $\frac{2}{3}$  more than diameter of eye, its inner fold slightly protruding upon the inferior half. Skin entirely free from spinules, everywhere longitudinally striated; lateral ridge strongly developed, but less conspicuous on head and distal end of peduncle. Lateral line gently curved and slightly undulating to a point midway between tip of pectoral and origin of dorsal where it descends more abruptly; thence nearly straight to base of caudal; a transverse line, divided mesially, above base of pectoral; a short branch curving behind the eye; another between hinder margin of eye and lateral ridge; main line carried forward from below hinder third of lower eyelid in a wide curve to the nostril; a short disconnected line, divided mesially, in front of nostril; a second line below lateral ridge from extremity of pectoral to base of caudal. Dorsal fin pointed, its length  $2\frac{1}{2}$  in its height, which is 2 in the head, its distance from the caudal  $3\frac{1}{2}$  in total length: anal fin originating below the middle of, shorter and lower than, the dorsal: caudal fin feebly rounded,  $4\frac{1}{2}$  in total length; depth of caudal peduncle immediately behind base of dorsal  $\frac{2}{3}$  of its width at the same place, its least depth  $4\frac{1}{2}$  in the head: pectoral fin rounded, with the upper angle slightly produced,  $1\frac{1}{2}$  in length of head. Upper surface lilaceous brown, mottled with gray, and closely dotted and lined with darker brown; lower half of sides gray with larger violet spots; below pearly white; an irregularly oblong, narrow, silvery ring in front of the dorsal.\* Dorsal and caudal fins violaceous; anal and pectorals whitish. Iris golden. (*perlevis*, very smooth: in reference to the complete absence of dermal spinules).

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\* Perhaps an individual peculiarity.

Type in the collection of the Amateur Fishermen's Association of Queensland, to which it was presented by Mr. Chris. Dahl, who caught it at Sandgate, Moreton Bay.

Finally, I have much pleasure in recording the following fishes, examples of which are in the collection of the Amateur Fishermen's Association, as new either to the Commonwealth or to the State Fauna.

To the Australian fauna should now be added—

*Paraplotosus albilabris* Cuvier & Valenciennes, Hist. Nat. Poiss., xv, p. 427, 1840: Batavia. A single specimen from Dunk Island; E. J. Banfield; Cat. No. 469.

*Sphyræna brachygnathos* Bleeker, Nat. Tijds. Ned. Ind., vii, 1854, p. 368: Batchian. Occurs in Moreton Bay; Chris. Dahl; Cat. No. 439.

*Apogon endekataenia* Bleeker, *ibid.*, iii, 1852, p. 449: Banka. Several specimens from Green Island (Cairns District) and Dunk Island, collected respectively by Messrs. E. J. Lyons and E. J. Banfield; Cat. Nos. 198 & 472.

*Apogon macropterus* Kuhl & van Hasselt: Cuvier & Valenciennes, *ibid.*, ii, p. 160, 1828: Java. A single specimen from Dunk Island; E. J. Banfield; Cat. No. 474.

*Stethojulis renardi* Bleeker, *ibid.*, ii, 1851, p. 253: Banda. Two specimens, one from Green Island, Cairns, E. J. Lyons, and one from Dunk Island, E. J. Banfield; Cat. Nos. 199 & 485.

*Teuthis nigrofuscus* Forskal, Descr. Anim., p. 64, 1775: Djidda. One specimen from Dunk Island; E. J. Banfield; Cat. No. 481.

*Pterois lunulata* Schlegel, Faun. Japon., Pisc. p. 46, 1843: Nagasaki. One specimen from Mooloolah; J. H. Stevens; Cat. No. 421.

Addenda to the Queensland fauna.

*Galeus australis* Macleay, Proc. Linn. Soc. N. S. Wales, vi, 1881, p. 354: Port Jackson. I have examined two specimens of this shark from Moreton Bay. The most northerly locality previously reported was "off Morna Point to the south of Port Stephens" (Waite, Mem. Austr. Mus).

*Engraulis antipodum* Günther, B. M. Catal. Fish., vii, p. 386, 1868: Tasmania and New Zealand. Visits our

southern shores in large shoals during the winter months. Southport, J. Douglas Ogilby; Cat. No. 686.

*Hyperlophus copii* Ogilby, Proc. Linn. Soc. N. S. Wales, xxii, 1897, p. 72: Maroubra. Same as preceding. Mud Island; J. Douglas Ogilby; Cat. No. 413.

*Aulopus purpurissatus* Richardson, Icon. Pisc., p. vi, pl. iii, fig 3, 1843. Occasionally taken on the Snapper Grounds off Moreton Bay, and ranging northward to Laguna Bay, Tewantin, whence I received a specimen through the courtesy of Mr. V. H. Jeff; Cat. No. 156. Also one from Mount Tempest; C. Russell; Cat. No. 339.

*Thunnus thynnus* (Linnæus), Syst. Nat., ed. 10, p. 297, 1758. I have examined two specimens of *Thunnus*, the first taken in Port Jackson, the second in Moreton Bay, and was unable in either case to find any characters by which they might be differentiated from the Mediterranean fish.

*Trachurus declivis* Jenyns, Zool. Beagle, iii, Fish. p. 68, 1842: King George's Sound. Visits our coast during the winter months. Cape Moreton; C. Sigley; Cat. No. 95.

*Apogon roseigaster* Ramsay & Ogilby, Proc. Linn. Soc. N. S. Wales, xi, 1887, p. 1101: Port Jackson. Abundant in the Brisbane River.

*Apogonichthys auritus* Cuvier & Valenciennes, Hist. Nat. Poiss., vii, p. 443, 1831: Mauritius. Two examples; Dunk Island; E. J. Banfield; Cat. No. 473: One example; Bell's Swamps, in fresh water; W. Weatherill.

*Acanthistius serratus* Cuvier & Valenciennes, ibid., ii, p. 399, 1828: King George's Sound. Two examples; Point Lookout; E. H. Shearwin; Cat. No. 425.

*Chilodactylus fuscus* Castelnau, Proc. Linn. Soc. N. S. Wales, iii, 1879, p. 376: Port Jackson. One specimen; Moreton Bay; V. H. Jeff; Cat. No. 172.

*Verreo oxycephalus* Bleeker, Notices Ichth., p. 7, 1862: Japan. One example; Arkwright Shoal; H. W. Haseler; Cat. No. 269.

*Acherodus badius* Ogilby, Edib. Fish & Crust. N. S. Wales, p. 134, 1893: Port Jackson. Not uncommon in the shop windows during the winter of 1906; not observed during that of 1907; again common in 1908.

*PlatyGLOSSUS immaculatus* Macleay, Proc. Linn. Soc. N. S. Wales, ii, 1878, p. 363: Port Darwin. One specimen; Dunk Island; E. J. Banfield; Cat. No. 484.

*Pseudolabrus gymnoensis* Günther, *ibid.*, iv, p. 117, 1862: Port Jackson. One specimen; Mooloolah; C. Sigley & H. W. Haseler; Cat. No. 178.

*Pseudolabrus nigromarginatus* Macleay, *ibid.*, iii, 1878, p. 35: Port Jack on. One specimen; Caloundra Banks; W. H. Sidle; Cat. No. 158.

*Olisthops cyanomelas* Richardson, *Ann. & Mag. Nat. Hist.* (2) vii, 1851, p. 291: King George's Sound. One specimen; Southport; H. Myers; Cat. No. 568.

*Cæsiusoma æquipinnis* Richardson, *Zool. Erebus & Terror, Fish.* p. 121, 1848: King George's Sound. Not uncommon on the Snapper Banks off Moreton Bay, but apparently not found inshore as is its habit further south.

*Atypichthys strigatus* Günther, *ibid.*, ii, p. 64, 1860: Swan River. Large examples are occasionally taken in the same localities as the preceding species.

*Parachætodon ocellatus* Cuvier & Valenciennes, *ibid.*, vii, p. 229, 1831: loc. ign. One specimen; Morteon Bay; Miss Gwendoline Fitzgerald; Cat. No. 446.

*Pseudorhombus novæ-cambiæ* Ogilby, *Proc. Linn. Soc. N. S. Wales*, xxiii, 1898, p. 296: Port Jackson. Not uncommon in Moreton Bay.

*Aserragodes macleayanus* Ramsay, *Proc. Linn. Soc. N. S. Wales*, v, 1881, p. 462: Port Jackson. I have seen specimens from the Brisbane River and trawled a pair off Caloundra.

*Synaptura nigra* Macleay, *ibid.*, vi, 1881, p. 49: Port Jackson. Not uncommon in our southern estuaries.

#### Addenda to the New South Wales fauna—

*Spilotichthys labiosus* Macleay, *Proc. Linn. Soc. N. S. Wales*, viii, 1884, p. 202: Wide Bay. Occurs at least as far south as the Tweed Heads.

In addition to the above, I provisionally refer to *Odontaspis tricuspidatus* Day (*Fishes of India*, p. 713, pl. clxxxvi, fig. 1, 1878: Karachi), a pair of large sharks captured in my presence some years ago on the coast of New South Wales in the course of a visit of inspection to the Manning River oyster beds by the late Hon. J. Want, Dr. James Cox, and others. Day's description agrees fairly well with my notes taken from the specimens in

question, except in respect to color, mine being of a dark steel blue above, whereas Day describes his as being "brown superiorly." The original specimens came from the coasts of Sind and Beluchistan, but Day mentions one in the British Museum from South Australia. They attain a length of twenty feet.

*Note a* :—In September, 1906, I received from Mr. T. F. B. Mullin the jaws of a shark captured in Table Bay by one of his employees, who had recently arrived from South Africa, having sailed direct from Capetown to Brisbane. On examination these proved to belong to a cestraciont shark belonging to the *Heterodontus philippi* group. As I am unaware that the family *Heterodontidæ* has as yet been recorded from the seas of the Cape,\* and as it is extremely unlikely that the Australian species should range so far westward, I propose to distinguish the South African form as *Heterodontus bonæ-spei*.

*Note b* :—Mr. J. T. Jamison, of Woody Point, having kindly obtained for me some of the fishes on which Macleay founded his *Atherinosoma jamesoni*† I am reluctantly obliged to announce their identity with *Pseudomugil signifer*, Kner.‡

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\* Shortly after receiving the specimen I wrote to the Curator of the South African Museum on the subject but have not as yet received an answer; 23rd June, 1908.

† Proc. Linn. Soc. N. S. Wales, ix, 1884, p. 171: Bremer River.

‡ Reise Novara, Fisch. p. 275, pl. xiii, fig. 5, 1867: Sydney.

# THE GLASSHOUSE MOUNTAINS.

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By **JOHN SHIRLEY, B. Sc.**

DISTRICT INSPECTOR OF SCHOOLS.

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*A Paper read before the Royal Society of Queensland  
on April 27th, 1907.*

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THE Glasshouse Mountains were discovered by Captain Cook in May, 1770, during his first voyage to southern seas. They were so named from their resemblance, at a distance, to the glass furnaces or glass houses with which Cook was so familiar in Northern England. They were sighted by Flinders in July, 1802, and are mentioned in his "Voyage to Terra Australis in H.M.S. The Investigator."

Mr. Stutchbury, who visited the Caboolture district in August, 1854, gives the following description of these strange peaks:—The special forms and characteristics which the Glasshouse Mountains present are peculiarly interesting. At first sight, hand specimens might be taken for a fine grained granite; but on examining these *en masse* and carefully viewing all the attendant circumstances, there can be no doubt that they are metamorphic sandstones. It is evident that no granite masses could have been projected in the form they now assume; they must have been surrounded by some supporting material such as the continuation or extension of the same strata would give, now removed by denudation. Upon careful examination, lines of stratification can yet be traced. The largest of these mountains, "Beerwah," presents precipitous faces, especially on the northern and eastern faces, exhibiting semi-basaltic columns leaning from the base towards the centre." "We can easily imagine that at a period subsequent to the coal measures there were as many foci of heat as there are now mountains."

The last part of Mr. Stutchbury's statement should have given him the clue to the formation of these remarkable mountains. He tried to account for their formation as masses of plutonic rocks, as igneous rocks which had crystallized at depths, and failed. If he had tried to account for them as volcanic rocks, he would have been more successful. He recognized that "there were as many foci of heat as there are now mountains," but he went no farther. The simplest explanation of their origin is that each marks the site of a volcano, once standing as a truncated cone, its sides built up of alternate layers of tuff and lava, and having a crater at its blunt apex. Below the crater and piercing the central axis of the mountain was the pipe up which molten matter made its exit at each volcanic outburst. After the last explosion, this pipe was filled with a plug of solidified lava that formed the hardest rock of the mountain. By denudation through successive ages all the softer parts of these volcanoes have been swept away. The slopes of tuff, or volcanic ash, and lava have gone, the crater has gone; except in the case of Crookneck or Coonowrin nothing is left but the plug of volcanic rock which filled the volcanic vent. Even this is now suffering denudation in turn. Round the base of each mountain is a talus of blocks, detached from its surface by the action of frost, running water and the daily variations of temperature. With one exception, they rise baldly from the coast plain on which they stand. This exception is Crookneck, which has as its base a small collar of Trias-Jura rocks.

The continuous rains of the first quarter of 1893 brought about an immense landslip on Crookneck, and the booming and rumbling of the rock slide caused some alarm in the neighbourhood; the fissure produced by the fall of this immense mass is plainly visible on its S.E. side.

In 1875, the late Sir Augustus Gregory, in his report on "The Geology of Parts of the Wide Bay and Burnett Districts," classes the Glasshouse Mountains with Mounts Cordeaux and Mitchell and Spicer's Peak in the Main Range; and with Mount Lindsay and Mount Barney in the Macpherson Range. He calls the rock in each case a porphyry, and says, "The porphyry consists of a pale brown paste with minute felspathic crystals, though it sometimes varies

so as to consist of very small grains of quartz with minute cavities, containing oxide of iron, resulting from the decomposition of pyrites. Occasionally, it is vesicular, and has the aspect of trachyte." In speaking of the rock as consisting of a brown paste, Mr. Gregory must have had rocks of the Beerburum type in view, and he very nearly gave their true composition when stating that they had the aspect of a trachyte. As a matter of fact, all these mountains are built up of forms of columnar trachyte in six-sided prisms.

Leichhardt compared the Glasshouses to the Puys of Auvergne, a group of detached cones scattered over the centre of France, some of which still retain their cone-shaped slopes and central crater, while others have reached the state of denudation shown in our Glasshouses, and are reduced to the central plug of crystalline rock. The Puys are also columnar in structure, as may be seen in the illustration handed round.

A letter of Leichhardt's, dated September, 1843, says : Last Saturday I returned from a trip to the Glasshouses ; the highest, Beerwah, is about 1,000\* feet high, and is composed of a rock entirely different from the surrounding mountains ; I have seen similar mountain features in Auvergne. Geologists have called this rock domite, because of its affecting the form of a dome. This domite belongs to the trachytic group.

The Rev. J. E. Tenison Wood believed the rocks of the Glasshouses to be basalt, and in his paper on the "Desert Sandstone of the interior of Queensland," published plates showing "Prismatic Basalt, Glass House Mountains."

Mr. Henry G. Stokes, formerly a member of this Society, was the first to show conclusively that the rocks of the Glasshouses belonged to the Trachyte class. Recently, Dr. H. I. Jensen, a Queenslander, and former resident of Caboolture, an ex-scholarship winner, and holder of a travelling science scholarship from Sydney University, has written two exhaustive papers for the Linnæan Society of New South Wales, in which the structure of the mountains, and the nature of their minerals have been fully discussed.

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\* The true height is 1,760 feet.



Visitors to the mountains should stay at Bankfoot House kept by Mr. Grigor,\* an old resident, who can supply horses and guides. The nearest railway station is Glass Mountain Station, distant about 45 miles north of Brisbane. Bankfoot House stands right in the centre of the Glasshouses. The mountains lie roughly on north and south lines in groups of three; each group of three lies on a transverse axis, cutting the N. and S. axis almost at right angles. Taking the three lying immediately north of Grigor's—Ngungun, Coonowrin and Beerwah—it will be found on ascending Ngungun, an easy feat by climbing round its south-eastern face, that the points of the other two lie from Ngungun in one and the same straight line. North of these, Mount Mellum, Mt. Blanc and Candle Mountain lie along a parallel straight line, and to the south on a third parallel lie Barren Mountains, Tibrogargan and Mt. Ewan, while south again on an east and west line are Beerburum and the twin peaks of Toonbubudla. The theory advanced by Mr. Lionel Ball, and by Mr. Jensen is that the north and south lines represent immense faults or fractures or lines of weakness in the rocks north of Caboolture, and that these fractures when formed along north and south folds cause smaller cross fractures. If we press with a straight piece of wood on the surface of a pie crust, the crust will not only break along the line of pressure, but also in numerous places at right angles to the main fissure. Mr. Stokes asserted that there were two or three main lines of fracture parallel to the coast, and that each extinct volcano was placed where the cross faults or fissures cut these.

The columnar structure of these mountains is evident from a distance, on each mountain the columns in the centre are vertical, but on the slopes are parallel to the angle of slope, and all converge towards the summit. The columns on Toonbubudla, the twin peaks, present a very curious structure. Where the end of a prism is exposed, it looks like a gigantic honeycomb, each column is again divided into many smaller prisms, which are similar in shape to the parent mass. The various peaks do not show the greatest effect of denudation on the side facing the sea,

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\* Since writing the above news of Mr. Grigor's death has been received.

and the prevailing winds. Ngungun is weathering most rapidly from the south, Coonowrin from the south-west, Beerwah from the north, and Toonbubudla from the north-west. Toonbubudla and Beerburum seem to weather almost equally towards all points of the compass.

The columnar structure may best be studied in the caves at the foot of the column on Coonowrin. Though they are usually six-sided, there are exceptions to the rule in four and five-sided prisms.

The most porphyritic rocks are those of Beerburum and Ngungun. The formerly usually weathers a rich red-brown. Specimens from Beerwah and Beerburum have been classified by Mr. Jensen as Trachyte; those from Coonowrin, Tibrogargan and Ewan as Comendite; and those from Ngungun as Pantellarite, a soda trachyte in which the percentage of silica ranges from 66.8 to 72.5, and alkalies, principally soda, amount to 10 p.c.

The heights of the principal peaks are:—Beerwah, 1760 feet; Coonowrin, 1170; Toonbubudla, 1020; all the others are below 1000 feet.

The Glasshouses arise from Trias-Jura beds, while immediately to the west of them are rocks of Carboniferous age. With regard to the age in which they were formed, all that we can say is that they are more recent than the Trias-Jura, and older than the surrounding basalts.

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# GRAPHICAL AND MECHANICAL AIDS TO CALCULATION.

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**By J. C. RÜNNICH, F.I.C.**

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*A Paper read before the Royal Society of Queensland  
on May 25th, 1907.*

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IN every station of life arithmetical calculations are absolutely indispensable: no trade, no profession, no calling, however humble it may be, can exist without a continual practical application of one of the three great R's in the solving of arithmetical problems. Such calculations become in many cases a monotonous mental drudgery, and from the earliest times mathematicians have tried to invent instruments and tables which should minimise such work in all scientific, commercial and industrial calculations.

In our present state of civilisation, in which the keen industrial competition becomes a veritable struggle for life, with "time is money" as its principal motto, such aids become more than ever invaluable, and I can positively state from my own experience, that with the help of graphical tables and more particularly with the use of slide rules, I have saved 75% of the time otherwise spent in calculations.

The object of this paper is to spread the knowledge of such instruments and to awaken the interest of a few, so that they like myself become apostles advocating the employment of graphical tables and of slide rules. This paper does not claim to be a scientific treatise on the subject, neither can I enter into explanation of the more expensive instruments, like arithmometer, used for complicated astronomical calculations, and the elaborate adding or counting machines, which are more and more introduced into the offices of our larger banking institutions.

C—ROYAL SOC.

I shall first treat briefly with graphical tables or diagrams, also called graphs, and show one of the oldest graphs in existence: Pythagoras table of multiplication (Table I., Plate 1). The construction is of the simplest, on a horizontal line ten equal divisions are traced, numbered from 0 to 10, the same is repeated on a perpendicular line erected on the zero point, and the whole square completed. Every product of multiplication is indicated by the point where the horizontal line of a given number crosses the vertical line of another number; by connecting all products of equal numerical value, a system of curves will be obtained, with the help of which the product of any two factors may be read off. Every line representing the same quantity is called an "*isoplethe*" (this term was first proposed by the German mathematician, Vogler, and has been universally adopted by others), and we find on this graph three series of isoplethes, two systems of straight lines representing the factors and a system of curves representing the products. To obtain the products with fractions of whole numbers, the values must be estimated by interpolation, which makes the table of little practical value. This table serves to illustrate the simplest of forms applied to three variables, in which two given values determine a third unknown.

The celebrated French engineer, Leon Lalanne, discovered the principle of *anamorphosis*, by which the construction of graphs is simplified, and their utility greatly increased. This principle is based on the following consideration:—Each scale must be considered extensible, as if drawn on a sheet of rubber, each scale can be so stretched and transformed that the curves become straight lines, which not only simplifies the construction, but greatly facilitates the reading. Lalanne thus modified Pythagoras table of multiplication by stretching the horizontal and the vertical scales in a peculiar manner with the result shown on the left of Table I. that the isoplethes of products become straight lines running diagonally, and cutting both the horizontal and vertical isoplethes at the number of their actual value. On this improved table of multiplication, the squares and cubes of numbers are easily found by drawing diagonal lines, for the squares from 1 to 100, and for the cubes from 1 to 3.162 ( $= \sqrt[3]{10}$ ) and from 3.162 to 100, and reading the results at the point of intersection of ver-

tical lines and diagonals. Lallemand, another French mathematician, was the first to construct hexagonal graphs, in which, with the aid of a transparent sheet, on which the three diagonals of a hexagon are drawn, the value of an unknown may be found from two given variables. He further extended the principle by making each of the scales a system of two variables and thus producing a graph on which the relation of six variables is recorded. On Table II., Plate I), which represents one of Lalanne's hexagonal graphs, we have thus three double systems, one with the variables,  $u$  and  $v$ , the second with the variables,  $y$  and  $z$ , and the third, with the variables  $w$  and  $x$ , and for  $u=30$ ,  $v=20$ ,  $y=50$ ,  $z=20$  and  $w=20$ , we find  $x=4$ . In the reading of these hexagonal graphs, attention has to be paid that the diagonals of the transparent sheet cut the systems perfectly perpendicular. With the help of similar tables, Lallemand succeeded in the general topographical survey of France to reduce to quite simple reading off, long complicated calculations, which previously occupied for days the time of several persons.

As a practical example of such a hexagonal graph, I give here a Table (III., Plate I), for the calculation of compound interest, constructed by Prévot, which for a given amount of capital, a given rate of interest and given time in years, allows to read off the amount of capital plus compound interest. For instance, £225 at 3 per cent. will increase in thirteen years to £328.

One of the greatest authorities on graphical calculations of the present day is the French engineer, Maurice d' Ocagne, who proposed the term *Nomographie* for this science, which term is now generally used in Europe, on which he published several works. He was the first to extend and simplify the principle of graphical calculations by inventing a system by which the three factors are read off on a straight line. I will give here an instance of this principle by showing a Table (IV., Plate I), published only a few months back, constructed by Fischer for the calculation of the amount of alcohol in wine. A wine with a specific gravity of 1.0520 yielded an alcoholic destillate with a spec. gr. .9778, contained in accordance with this table 13.84 per cent. by weight of alcohol.

D'Ocagne extended the science of *nomographie* in every direction and he succeeded in laying before the French Academy of Science a method by which he constructed nomographs with ten and more variables. I will give here another example of one of d'Ocagne's nomographs, as applied to higher mathematics, the graphic solution of the cubic equation,  $z^3 + pz + q = 0$ , we find from Table VII. that for  $p=2$ , and  $q=-6$ ,  $z=1.46$ .

As another instance of reading a result with the aid of a straight line, I will give here a very simple graph, which I constructed for use in sugar laboratories for the calculation of the well-known value *Pure Obtainable Cane Sugar*, or P.O.C.S. in sugar cane (Table V., Plate II.) In cane juice, the amount of total solid matter is determined by a density determination with the aid of Brix or Beaumé spindle. The degree Brix express the percentage of total soluble solid matter in the cane juice, which value is read off in our table on the third perpendicular scale on the right. The amount of cane sugar in the juice is determined with the help of the saccharometer or polariscope, the value found is read off on the centre scale, by connecting the per cent. of brix and per cent. of cane sugar by a straight line, the amount of P.O.C.S. is read off on the left hand scale where it is cut by this straight line. I may be allowed to explain that the amount of sugar obtainable by the process of manufacture not only depends on the actual amount of cane sugar in the juice, but also on the amount of soluble impurities, and from practical experience the manufacturer estimates that one-half of these impurities have to be deducted from the per cent. of cane sugar in the cane. We have for instance two cane juices both nineteen degrees Brix, one with seventeen per cent., and the other with fifteen per cent. of cane sugar, the former has sixteen per cent. and the latter only thirteen per cent. P.O.C.S.

I will now show a chart which I constructed for the use of dairies and butter factories, by the aid of which for a given quantity of milk containing a certain per centage of butter fat, the amount of commercial butter which should be obtained by churning, may be read off. (Table VI., Plate II). A cow giving, say, 21lbs. of milk with a 3.8 per cent. test, would yield 14ozs. of commercial butter a day. The formula

used for the calculation of the result is not a simple one, as shown on the top of the table, but by the aid of this nomograph correct results are obtained, without turning over pages and pages of tables of the tabulated works generally used in our factories, which tables moreover give the results in pounds and decimal points of pounds which values are not so intelligible to our farmer. A similar chart I constructed for the calculation of commercial butter from given quantities of cream. As a further instance, I will show here a table used for the calculation of the amount of water evaporated to concentrate a sugar juice of a given degree Brix into a syrup of certain degree Brix. The original table gave the amount of water evaporated in per centage of weight of the original juice, I extended the utility of the table so as to be able to find directly the gallons of water evaporated per 100 gallons juice.

With the graphical aids to calculations may be included an ingenious little instrument, costing only a few shillings: the *mathematical Cinderella*, or *Engineer's Messknecht* (measuring or rather computing servant), so called by its inventor, Hofrath Prof. Max Pressler. This table of handy pocket size, constructed of strong card board, has on one side a complete table of logarithms from four to five places, with many other useful data and constants with reference to weight and measures, etc. On the other side are other graphical tables of reciprocals, circumference and surfaces of circles of various diameters, squares and cubes of numbers, chords, arcs, sines, cosines, tangents and secants of all angles. The instrument may be used, like a regular multum-in-parvo, for rough surveys and levelling, for the estimation of true sun time, the estimation of heights of trees and mountains, for the estimation of the cubic contents of standing and felled trees. To give an instance how handy the arrangement of these tables are for calculations, which otherwise would require large volumes of tables, I will give an example taken at random from the little pocket book, issued with the instrument. In a railway to be constructed, the line of rails has to change its direction by an angle of 31.4 degrees, and the lines have to be connected by a curve 200 yards radius (See Plate II.) The surveyor wishes to know :—



1. Length of chord  $BC=200 \times \text{chord } 31.4 \text{ degrees}=2 \times 54.12=108.24 \text{ yards}$  ;
2. Height of arc  $FS=200$ , height of arc  $31.4=2 \times 3.73=7.46 \text{ yards}$  ;
3. Length of arc, curve  $CFB \text{ degrees}=200 \times \text{arc } 31.4=200 \times .548=109.67 \text{ yards}$  ;
4. Surface of segment  $=200^2 \text{ seg. } 31.4 \text{ degrees}=40000 \times .0134=536 \text{ sq. yards}$  ;
5. Distance  $CD$  and  $DB=200 \times \text{tang. } 15.7 \text{ degrees}=200 \times .281=56.2 \text{ yards}$  ;
6. Distance  $DM=200 \times \text{sec. } 15.7 \text{ degrees}=200 \times 1.038=207.6 \text{ yards}$ .

I will now pass to the mechanical aids to calculation and draw first attention to the simplest of all such instruments the ordinary ball frame, which is still extensively used in all business houses in Russia, and is also in common use in China and a few other countries. It is quite a revelation to see a Russian bank clerk doing all his adding up and other calculations with the help of a ball frame, with the greatest of speed and absolute accuracy, and with the great advantage that he may be interrupted at any time during his calculations without affecting the result. Some years back a small portable instrument was patented in America, the "Locke Adder," which is based on the same principle as the ball frame, and is worked in exactly the same manner. It is of great advantage for adding up, but not so easily applicable to our system of money with its pound, shillings and pence. With practice any arithmetical operation addition, subtraction, multiplication and division may be done with the little instrument.

By far the most general useful of all the mechanical devices invented to aid calculation are *sliderules*, of which a great many forms exist. In 1624, ten years after the invention of logarithms by the Scotchman, John Napier, who published the first table of his natural or hyperbolic logarithms in 1614, the English mathematician, Edmund Gunter, constructed a rule which he divided in proportion with the logarithms of numbers, with which he used a pair of compasses to obtain results of multiplication and division. Gunter was a colleague of Prof. Henry Briggs, of Gresham College, London, who was the originator of the more gener-

ally used decimal or common logarithms. Already in 1657 Seth Partridge constructed a logarithmic slide rule with Gunter's scales, which is really the forerunner of all the sliderules in use at the present day. Although England is the home of the original inventors, the use of sliderules made very little progress in the country, and only within recent years more attention has been given to the little instrument, which is becoming of more general use. In France, Germany and other European countries sliderules are very much more extensively used, and are not only used by nearly every scientist, but are found in the hands of every artisan, mechanic and engineer. The reason that sliderules are less used in England and its Colonies lies unquestionably in the fact that the ordinary worker on account of the complicated system of weight, measures and monies, is not so accustomed with the use of decimals, but does most of his calculations with vulgar fractions.

The principles, a mechanical and mathematical one, on which the use of sliderules are based, are exceedingly simple and easily understood. We will first consider the mechanical principle, which is easily demonstrated by taking two ordinary scales divided into 10 equal parts, in contact with each other (Table VIII., Plate III), by now moving the lower scale until the zero falls below a certain number, for instance three, in the upper scale, we will find that every other number on the upper scale is equal to the sum of the coinciding number on the lower scale plus three. This gives a simple method of adding a number taken on one scale to any number on the other scale. Similarly subtraction may be demonstrated by placing the number to be deducted underneath the number from which it has to be subtracted, for instance, four from seven, and to read off the result of the subtraction over zero of the lower scale on the upper scale, which equals three. For certain operations the lower scale may be inverted, and in this case we will find that the sum of all the coinciding figures on the two scales is constant, and as an example we find on our table that this sum of numbers is seven. We now see that with the slide inverted the sum of the numbers is constant, whereas with the slide direct the difference of numbers is constant.

The mathematical principle is equally simple, and is based on the theory of logarithms, in accordance with which multiplication of numbers is simplified into the addition of their logarithms, division into subtraction, the raising of a number to the  $n$ th power by multiplying the logarithm by  $n$ , etc. On a slide rule the two principles are combined, the scales are divided in accordance with the logarithms of numbers, and we find at once that the mode of division is exactly the same as on Lalanne's table of multiplication. If we have now two such logarithmic scales in contact with each other, and place for instance the index 1 of the lower scale under the 2 on the upper scale, we find that in all pairs of numbers in coincidence the number on the upper scale is the product of the number of the lower scale multiplied by two. Again we find that all pairs of numbers are in direct proportion with each other, in our case  $2 \div 1 = 4 \div 2 = 6 \div 3 = 8 \div 4 = 10 \div 5$ .

If we invert the slide or lower scale, we will find in accordance with the mechanical principle that the products of all numbers in coincidence are constant, in our case  $5 \times 1 = 2 \times 2.5 = 2.24 \times 2.24 = 7.07 \times 7.07$ , which latter numbers are on the square roots of 5 and of 50.

On the ordinary *Mannheim sliderule* of 25 centimeter or about 10 inches length we find two scales of divisions from 1 to 10 each on the upper part of the rule, and a scale from 1 to 10, but of double length on the lower part of the rule, and similar scales on the upper and lower part of the movable slide. With this rule only approximate values (A, Plate III), can be obtained, which for most calculations is quite sufficient. The reading of the subdivision requires some practice. On a sliderule all operations of calculations are made irrespective of the decimal point, and for instance the values of .0265 or 2.65 or 2650 are taken on the same place on the scale. Rules exist to ascertain the position of the decimal point, but they are rarely required, as in practical calculations the position of the decimal point is generally self-evident.

As the accuracy of the results of operations made by the aid of a slide rule depends entirely upon the number of subdivision on a given length of scale, sliderules of great length up to three feet have been constructed, which how-

ever, on account of their length, become unwieldy. The lengthening of the scale may also be achieved by dividing the scale into two halves, with the first half of the scale on the upper part of the rule, and the second half on the lower part, and to make the instrument with two slides, as in the slide rule invented by E. Peraux, which although only 25 centimeter long, corresponds in accuracy with a rule 1 metre long, and gives results accurate to at least four figures (Plate III., B.). Of still greater accuracy is the *cylindrical slide rule* of Prof. George Fuller, in which a logarithmic scale over 40 feet long, is wound round a movable cylinder, and with which calculation with an approximation of  $1 \div 10,000$  are obtained. On this instrument we have only one scale of numbers and the operations are based on the same principle as originally employed by Gunter, by taking the first factor from the scale with the aid of two indices, and then moving the scale and reading off the result on the scale with one or the other of the indices. This sliderule gives by far the most accurate results, but has the disadvantage that if several operations with a constant factor have to be made, the scale has to be shifted every time. This drawback is avoided in the horizontal cylindrical slide rule by Thacher, which has a scale of 30 feet length, divided into 40 parts of equal length arranged parallel on a moving cylindrical slide, which is surrounded by a framework of triangular bars carrying similar scale. With this rule nearly the same approximation as in Fuller's rule is obtained, but with the great advantage that a series of multiplications or divisions in which one of the factors is constant can be made with only one setting of the slide. The bars further carry a scale of squares which gives a much greater range of possible calculations. Furthermore the slide has two series of scales running parallel so that the results may be generally obtained at two different places, and unnecessary shifting and drawing out of the slide is avoided. Both Fuller's and Thacher's rule are only for office use.

Quite of late years the ordinary Mannheim rule has been greatly improved by *Prof. A. Beghin*, who introduced his new slide rule (Plate III., D and E.) towards the end of 1898, and which now almost entirely replaces the older

sliderules, as it gives much greater accuracy than any other rule of the same length, is easier to work, and has a far greater range of possibilities in calculations, as for instance it allows with only one setting of the slide direct multiplication of three numbers or the finding of the quotient of a number divided by the product of two numbers. Calculations like  $x=a.b.$ ,  $x=a.b.c.$ ,  $x=a.b.+c$ ,  $x=a \div b$ ,  $c$ ,  $x=\sqrt{a}$ ,  $x=\sqrt[3]{a}$ ,  $x=a.b^2$ ,  $x=a^2+b$ ,  $x=a:\sqrt{b}$ ,  $x=\sqrt{ab}$ ,  $x=\sqrt[3]{a}$ ,  $x=a^2\sqrt[3]{b}$ ,  $x=\sqrt[3]{a^2b}$ ,  $x=a^3+b^2$ ,  $x=\sqrt{a^2+b^2}$ ,  $x=(\sqrt{a}+\sqrt{b})^2$  can be solved with the greatest of ease with one single movement of the slide. Special scales on the reverse of the slide give natural sines and tangents of angles, and allow trigonometrical calculations.

Just to give one example of the use of the sliderule in technical calculations. In order to make the results of analyses strictly comparable the results of the analysis are calculated on to the percentage of dry substance. We find for instance a sample of sorghum containing after air drying 10.15 per cent. of moisture, to contain starch 23.80 per cent., soluble carbohydrates 10.65 per cent., fat 2.56 per cent., ash 7.06 per cent., woody fibre 36.60 per cent., nitrogen 1.225 per cent., and proteins 7.35 per cent., and with one setting of the slide by setting the 10 on the rule to 89.85 amount of dry substance on the slide (as on top of double rule, Plate, III., B), we can read all the results off from the amounts taken on the slide with the coinciding figures on the rule and get 26.50 per cent., 11.86, 2.85, 7.86, 40.75, 1.364, 8.18 per cent. respectively.

Practical calculations are very much simplified by using conversion factors or gauge points, for instance, to convert feet into metres we use the proportion feet : metre as 292:89 or the factor .3048. The relation between the circumference of a circle and its diameter is very accurately expressed by the factor 710:226. If we read an European work on agriculture we find all the results of harvest expressed in hectolitres per hectare, and we can convert this into bushels per acre by multiplying the numbers by the factor 1.1133, or setting the slide to the proportion 150/167.

Every user of the sliderule, after becoming once familiar with the instrument, will find that certain factors are mostly

used in his calculations and he can fix them by making marks either on the rule or on the slide. Movable metal runners, called cursors, which have a fine vertical line marked on a piece of glass, facilitate in many cases the operations and the setting and reading off, but are particularly useful in continued operations like  $a.b.c.d. \div e.f.g.$

I may here add that for office use slides with the scales arranged on circles have been constructed, which, however, have no advantage over the slides already mentioned. Another pocket arrangement is a scale invented by *Proell*, on which we have a scale divided into ten equal parts printed on a small card, and a similar scale printed on a transparent sheet of celluloid, which is moved on top of the scale on the cardboard.

I trust that the examples I have given are sufficient to clearly demonstrate the value of mechanical and graphical aids to calculations, and so that they may be more commonly be used as time and labour saving instruments.

In order to enable any student to get some more information on this interesting subject, I will enumerate a few of the publications dealing with graphic calculations and slide rules :—

L. Lalanne.—Memoires sur les tables graphiques et sur la géométrie anamorphique.

do. Méthodes graphique pour l'expression des lois à trois variables.

Lallemand.—Les abaques hexagonaux. Feuilles lithographiées en 1885.

M. d'Ocagne.—Nomographie.—Paris, Gauthier Villars.

do. Sur une méthode nomographique. "Comptes rendues de l'académie des science," juillet 1893.

L. Lalanne.—Instruction sur les règles a calculs. —Paris.

Quintino Sella.—Teorica and pratica del regola calcolatore. Torino.

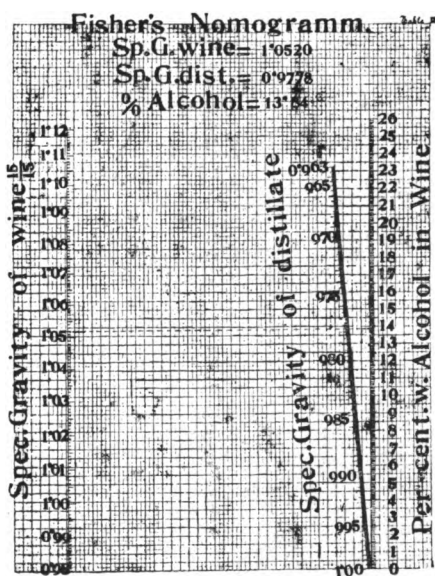
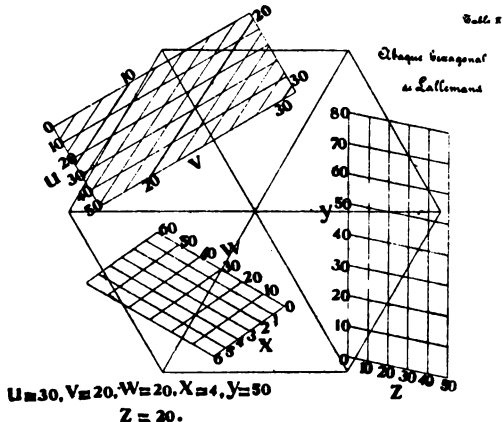
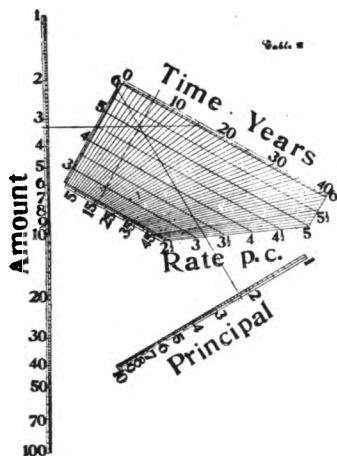
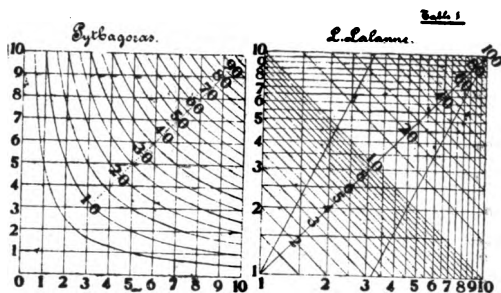
Elliot.—A treatise on the slide rule. London.

A. Beghin.—Règle a calculs. Paris.

C. N. Pickworth.—The Slide Rule.—Emmott and Co. Manchester and London.

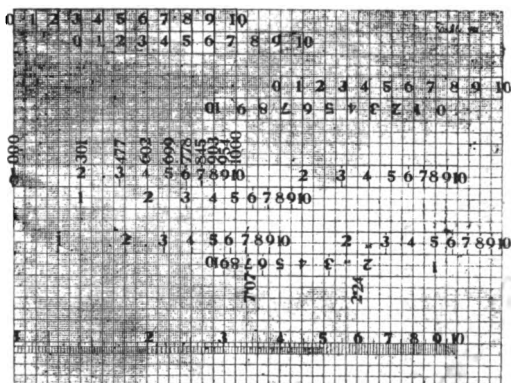
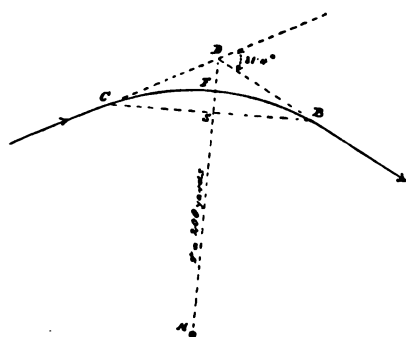
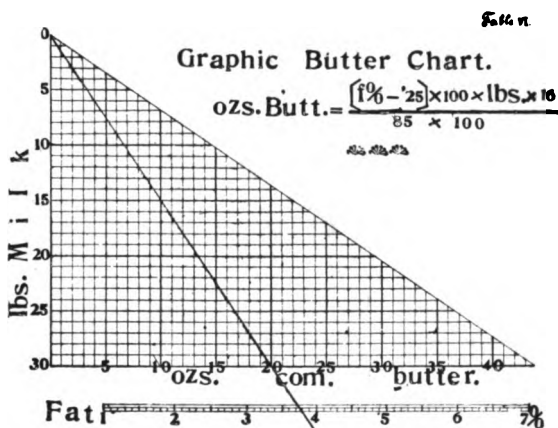
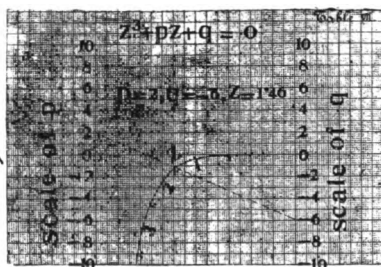
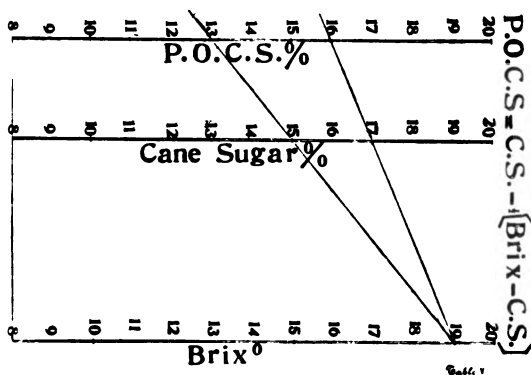
M. R. Pressler. — Mathematisch — Polytechnische Brieftasche mit Ingenieur Mess-Knecht.—Wien. Moritz Perles.





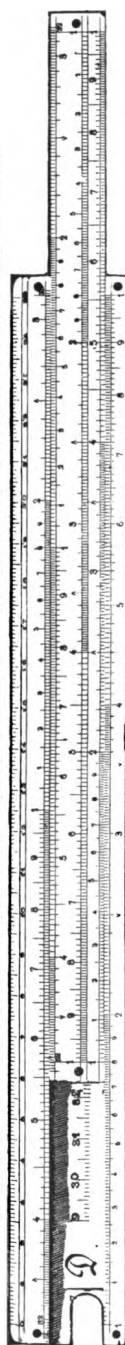
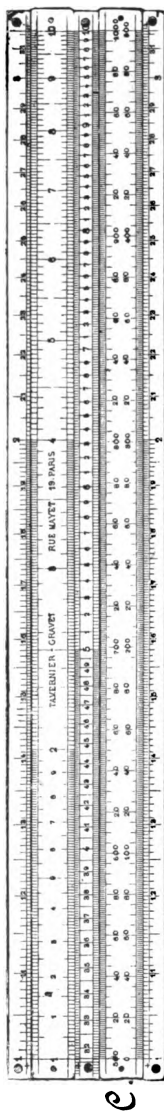
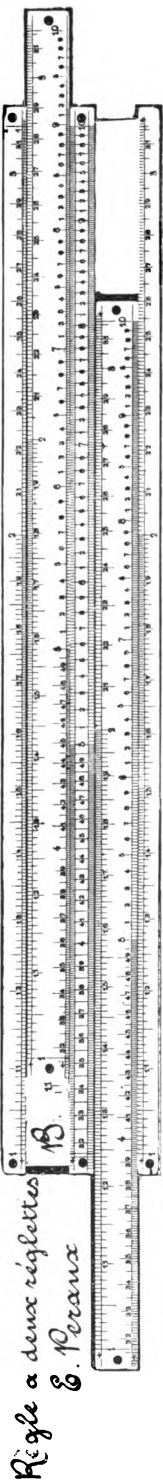
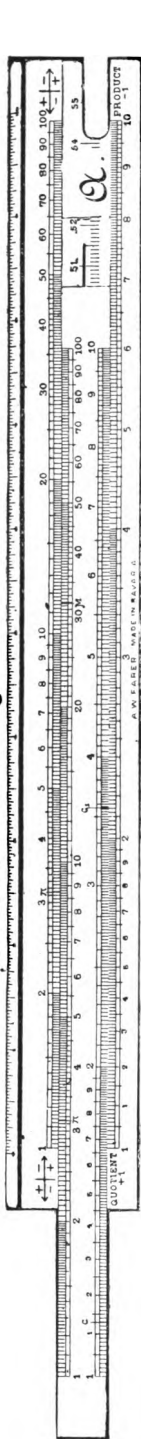




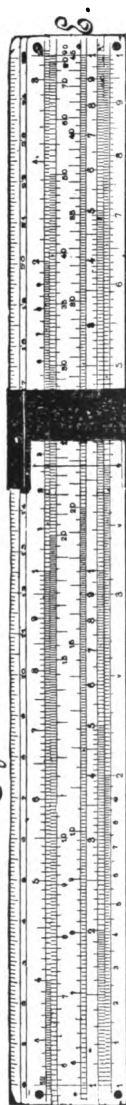




# Mannheim Rule



# Règle Begbin





## AN AUTOMATIC HOUSEHOLD FILTER.

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*A Paper read before the Royal Society of Queensland,  
on June 27th, 1907.*

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**and H. WASTENEYS, F.C.S.,**

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OWING to the water supply of Brisbane being delivered in an unfiltered state, and to its being at times of drought or flood undrinkable and exceedingly dirty, an attempt was made at the house of one of us (Mr. Henderson), to establish an automatic filter for the filtration of the water, which is delivered there from the Brisbane River supply. A similar filter had been found to give very good results with the "soft" Enoggera supply at the Reservoir, but this was the first attempt to treat the "hard" Brisbane River water by this method.

A corrugated galvanized-iron tank was made as in the diagrammatic sketch, with outlet pipe for the filtered water, wash out pipe with cock at the bottom, draw-off pipe with cock at the centre to run off water when cleaning top sand, and overflow, in case of flooding, at the top, the three latter openings being connected to the waste discharge. A perforated galvanized-iron pipe, three inches in diameter, was put down for the underdrain, and over this there was carefully packed washed gravel and sand as per sketch, to constitute the filter. The sand reached up to the level of the draw-off cock. A float in this filter was connected by a cord running over two pulleys to a swing arm attached to the outlet pipe, and to the storage tank pipes by barrel unions, as shown in sketch. To prevent syphon action,

a small pipe is let in at the top bend of the swing arm to admit air. By this means a rise of level of water inside the filter lowers the outlet, so that each inch increase of rise in water level gives virtually two inches more pressure on the filter, thus practically doubling the head of water that can be obtained in the filter. The fall of the swing arm also calls attention to the fact that the filter is choking, but the fall is so gradual that a month can elapse after the arm starts to fall ere cleaning is necessary. Before the filtered water pipe enters the storage tank, there is a draw-off pipe with cock connected to the waste discharge, so that the filtered water can be run to waste for two days after cleaning off the top sand, and thus save the contamination of the clean water already in the storage tank. As the filtered water is always found to be absolutely devoid of oxygen, it is run over an aerator before going into the storage tank. The stored filtered water in the tank is always saturated with oxygen. The pipe from the water main passes close up beside the storage tank, and a floating ball connected through a slot in the tank with a ball cock on the pipe, controls the supply to the filter. The drawing off of water from the storage tank lowers the ball, opens the cock, and water is delivered on the filter until the filtered water again rises sufficiently to close the cock. To regulate the supply to the filter, a small cistern, just large enough for a ball cock, is placed over the filter. In our case, nine inches of water was the depth obtained in this cistern. In the bottom of this cistern there is a standard orifice, with about quarter of an inch of pipe around it to ensure the water dropping straight down and not running along the under side of the cistern. The diameter of the orifice is so adjusted that with the head of water obtainable in the cistern, it delivers water on to the filter at the standard rate of three million gallons per acre of sand surface per twenty-four hours, and cannot possibly deliver faster than this. As the ball cock in the cistern of course delivers at a much greater rate than this, the cistern is nearly always full when the filter is working. The water delivered from the main is practically devoid of oxygen, so we aerate the water by running it down a ripple on to the side of the tank, and find by that means that the water on top of the filter

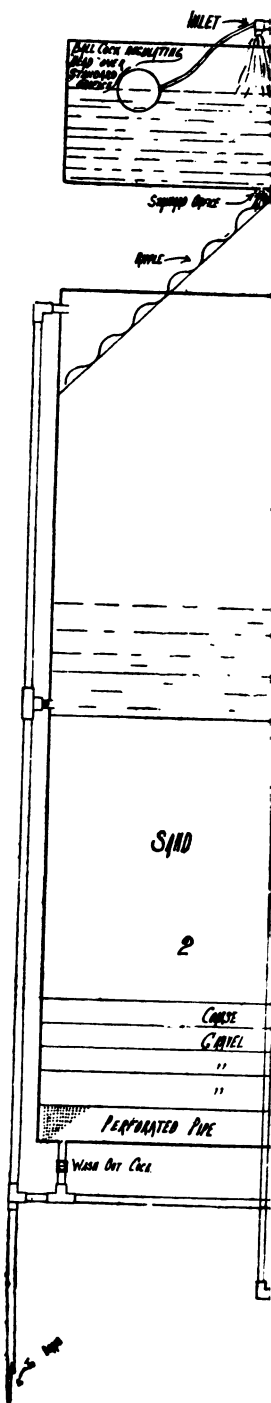
is saturated with oxygen. By this arrangement of controlling the supply first from the storage tank as to quantity, and secondly, from the cistern as to rate, we have found that the filter works quite automatically. It has been in use for over twelve months with no attention, save that on one occasion, after running nine months, the top quarter-inch of sand on the filter was removed and thrown away. The storage tank, filter and cistern were covered, and made mosquito proof, and the inside of each painted with "bitumen" paint.

The chemical analysis of the filtered water shows that there is always a large decrease in the albuminoid ammonia and in the "oxygen consumed," and the color is almost entirely removed. Saprophytic bacteria only are found in the filtered water, averaging from 50 to 100 per c.c. The intestinal bacilli, especially *coli communis*, are always present in the main supply, but have never been found in the filtered water. On one occasion, when the Brisbane River was in high flood, and dark brown, muddy water was being supplied, the filtered water was slightly opalescent, and had a yellowish colour, but that disappeared in a week.

As a result of the use of this filter, there is always on hand a supply of 600 gallons (the capacity of the storage tank) of pure, clear filtered water, which is used for drinking, cooking, and the bath. The advantages of a pure, clear water supply need not be pointed out—they have been well-known for many years. By the use of a filter of this kind, which only costs comparatively a few pounds, such a supply is always assured, while none of the small domestic filters generally in use, although requiring constant attention, can give a supply for the kitchen and bath room, very few of them remove the bacilli present, and a large proportion of them serve as breeding grounds for objectionable microbes.







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# A NEW TEST FOR MERCURY

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By **P. W. JONES, A.I.C.**

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*A paper read before the Royal Society of Queensland,  
27th June, 1907.*

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THE test is really the application of the action of mercury upon aluminum. When aluminium is rubbed with wash leather impregnated with mercury, combination takes place, forming an amalgam. This action is materially assisted and hastened by placing a drop of a solution of a caustic alkali on the aluminium before rubbing. When exposed to moist air, the alloy loses its lustre and the surface becomes oxidised with the formation of concretions of white aluminium oxide, and the liberation of mercury, at the same time evolving a considerable amount of heat.

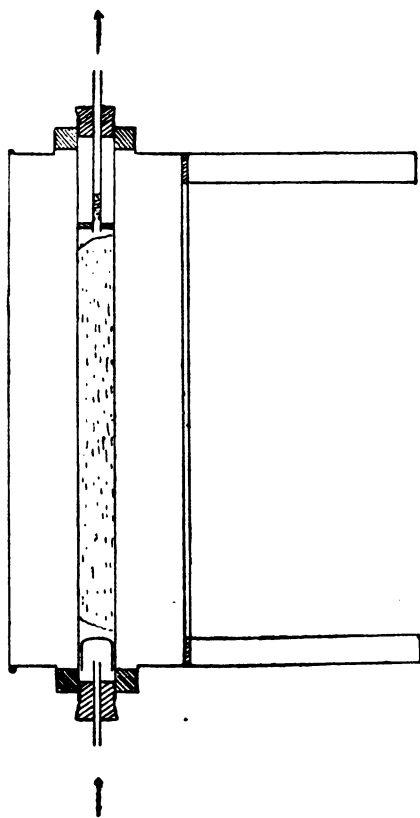
The test as applied in Toxicology is of considerable value in that very small quantities may be readily detected ; thus, a convenient portion of the sample is taken, placed in a flask together with a small strip of copper foil attached to a platinum wire and boiled as in Reinsch's test. The copper is then taken out of the solution, washed lightly with hot water, then with alcohol, and ether, dried, and cut into strips and placed in a small hard glass tube, sealed at one end and the mouth expanded. The tube is then suspended in a hole in a stout brass or copper plate. Over the mouth of the tube is placed a piece of metallic aluminium, previously cleaned, and a drop of water on the top of the aluminium to prevent the temperature rising too high. The bottom of the tube is then carefully heated to a dull red heat, kept at that temperature for a minute or two, then allowed to cool. Take off the aluminium strip, and rub the part where the mercury may be deposited with a wash leather moistened with a drop of caustic alkali, allow to stand in a moist atmosphere for a few minutes, charac-

D—ROYAL SOC.

teristic growths of  $\text{Al}_2\text{O}_3$  will be seen if mercury is present. 1-500th of a grain of mercury may be detected in viscera, etc., by this method. The advantage this method has, is that small quantities of impurities such as fatty matters do not interfere.

To detect small quantities of mercury in an ore.—Take from 0.5 to 1 grm. of the thoroughly sampled and finely ground ore and mix with about an equal bulk of lime and a little reduced iron (or other reducing agent), and place it in a small combustion tube placing a strip of aluminium, previously cleansed, over the mouth, and heat the mixture to dull redness, keeping the aluminium cool with a few drops of water. Then rub the aluminium with a wash leather moistened with a caustic alkali solution. If mercury is present in the ore, there will be the characteristic growth of alumina.

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# THE DETECTION OF SMALL QUANTITIES OF MERCURY IN EXPLOSIVES.

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**J. BROWNLIE HENDERSON, F.I.C. and P. W.  
JONES, A.I.C.**

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*A Paper read before the Royal Society of Queensland,  
27th June, 1907.*

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CONSIDERABLE trouble has arisen recently through the use of mercuric chloride by certain manufacturers in making up explosives, and this addition as is well-known masks the Abel Heat Test.

So far as we have heard in Brisbane, both from published accounts and from private sources, no satisfactory chemical method of detecting the small quantities of mercury present in the explosives has yet been discovered, and in some prosecutions in London for the presence of mercury in explosives, the Government witnesses, including among others, Dr. Dupre and Sir Wm. Ramsay, relied solely on the spectroscopic method for the detection of mercury. In communicating with Mr. W. A. Hargreaves, Government Analyst of South Australia, on this subject, he informs us that the following method has been found to work well qualitatively in his Laboratory: 100 grammes of the explosive was ground up with 100 grammes of french chalk and heated in a flask in a water oven. Air was drawn through the flask gently for two hours, and then passed through dilute sulphuric acid to absorb the mercuric chloride volatilised. This acid was subjected to electrolysis, using a gold cathode and platinum anode. The gold was then dried and heated in a small combustion tube and the mercury volatilised on to a microscope slide and examined under the microscope. We had succeeded in detecting traces of mercury by one or two rather long and unsatisfactory wet methods, but on getting this information from Mr.



Hargreaves, we also adopted the volatilisation method, that he and Dr. Duprè had found useful, and with our method of abstracting the mercury from the vapour found the detection of mercury easy both qualitatively and approximately quantitatively.

A number of preliminary experiments were made and we determined that mercuric chloride could be easily and completely volatilised at 100 degrees C., that a very small quantity of silver foil absorbed the mercuric chloride vapour quantitatively at 100 degrees C., and that on heating the silver after the experiment in a combustion tube in the usual manner the mercury could be readily recognised even in small fractions of a milligram.

The apparatus shown in sketch was then constructed. The water bath is 450 mm. long by 150 mm. wide and 150 mm. deep, on legs 200 mm. long. At each end is a hole 70 mm. diameter, with a short collar projecting 20 mm. An indiarubber cork fits each hole, and a glass tube 30 mm. in diameter and 510 mm. long passes through the rubber corks, thus enabling the tube to be surrounded with boiling water. 100 grammes of the explosive to be tested is ground up with 100 grammes of the French chalk prepared for heat test work, and the mixture run into the tube while it is held nearly vertical, a temporary stopper being put in the tube 60 mm. from one end. We found it convenient to do this while the tube was in place in the bath. The 200 grammes of mixture then loosely occupy about 350 mm. of the tube. At the shorter unoccupied end of the tube, a glass "thimble" about 25 mm. in diameter is inserted close to the mixture to prevent back currents and in the end of the tube is inserted a cork and through the cork passes an open glass tube of about 5 mm. diameter. This provides for the inlet of air. A perforated cork is fitted into the other end of the large tube and through the perforation is fitted a small glass tube about 5 mm. diameter and 140 mm. long. Close to the inner end of this narrow tube there is a constriction and pushed up against the constriction so as to loosely fit the tube are two leaves of silver foil, occupying about 15 mm. in length of the tube. By this means the mercuric chloride vapour never comes into contact with a cold surface, the tube and silver foil being

of course also at 100 degrees C., thus preventing loss by condensation. To prevent back currents into the colder end of the wide tube, a section of cork about 5 mm. thick that just fits snugly into the wide tube is fitted over the inner end of the narrow tube, and the tube pushed in till it nearly touches the explosive mixture. There is thus no "dead air" in the large tube and the air sucked through it does the maximum quantity of work in sweeping through the vapour of mercuric chloride. When the apparatus is fitted together, the bath is filled with water, and the water boiled. The "silver" end of the tube is connected to a small wash bottle containing water to control the rate of flow by observing the air bubbles, and the wash bottle connected to a graduated aspirator so that the volume of air drawn through can be measured. We found by experiments that no mercury escaped the silver foil when the rate of suction was not greater than eight litres per hour, and this rate was adhered to in all our experiments.

In testing the method, an explosive was first taken which, from its normal heat test (17 minutes) and British origin was presumably free from mercury. The tube containing the silver was weighed before starting the experiment. The explosive mixed with the chalk was heated for two hours and 16 litres of air drawn through. On withdrawing the tube containing the silver, drops of liquid which proved to be nitro-glycerine were noticed in this (and in every other experiment) on the inside of the outer portion of the tube. The tube was therefore washed out with ether (care being taken that no silver was removed) dried, and weighed. In two experiments with this explosive there was no alteration in the weight of the tube and no mercury was recovered from the silver on heating in a combustion tube. The silver was, however, slightly discoloured in each case, probably due to a trace of oxidation, but as there was no increase in weight, the oxidation must have been very slight.

100 grammes of this same explosive were then ground up with 100 grammes of French chalk which had been thoroughly mixed with two ccs. of a solution containing 1 milligram of mercuric chloride per cc. This was equivalent to 1 part of mercuric chloride in 50,000 parts

of explosive. At the end of two hours heating the tube containing the silver had gained 1.4 milligrams, and after another two hours had gained a further 0.4 milligrams or 1.8 milligrams recovered from two milligrams added.

The silver foil was transferred to a small combustion tube 40 mm. long by 5 mm. diameter with ground top, which fitted into a hole in a thick copper plate in the usual way. A microscope slide was placed on top of the tube and a little water on the slide to keep it cool. The tube was heated to redness, and the sublimed mercury condensed on the microscope slide. It was visible as a grey stain to the naked eye, and with a power of 118 diameters under the microscope, the mercury globules were easily distinguished.

Several other experiments were made with the addition of known quantities of mercury chloride, and in every case a recovery of nearly 90 per cent. in 3 hours heating was obtained.

This experiment was repeated with French chalk, to which had been added 1 cc. of mercuric chloride solution containing 0.1 milligram per cc. equivalent to one part of mercuric chloride in one million of explosive. No attempt was made in this case to weigh the tube, nor was a stain visible to the naked eye on the microscope slide, but under a power of 118 diameters many globules of mercury were distinctly visible, so that even smaller proportions than one in a million could be detected with certainty.

A sample of explosive which gave no reaction in the Abel Heat Test in three hours, but which gave the reaction in 17 minutes when thoroughly ground with one leaf of silver foil, gave an increase of 1.4 milligrams in the tube containing the silver foil in the first two hours and a further increase of 0.4 milligrams in the second two hours, thus agreeing exactly with the experiment in which one part of mercuric chloride had been added to 50,000 parts of explosive. On heating the silver as before, globules of mercury were easily recognised with the microscope. A second test of this explosive gave exactly similar results.

Another brand of explosive where the heat test had been lowered from 63 minutes to 9 minutes by grinding with one leaf of silver, gave a gain of 1.6 milligrams in the

first two hours and 0.2 milligrams in the second two hours, the sublimed mercury from the silver being again easily recognised under the microscope. In this experiment a third silver leaf was inserted in the tube close to the others and tested separately for mercury in the sublimation tube, but none was obtained, again confirming the result that air passing at the rate of 8 litres per hour carried no mercuric chloride past the first two leaves. Judging by appearance, the whole of the mercuric chloride is absorbed by the first 5 mm. of silver leaf.

From the above results it seems that not only does the method afford a rapid and easy means of detecting the presence of mercuric chloride in explosives, but enables a fair estimation to be made of the quantity present.

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# THE ORIGIN OF AUSTRALIA.

**By Sydney B. J. Skertchly, (Past President.)**

LATE OF H. M. GEOLOGICAL SURVEYS OF ENGLAND & QUEENSLAND.

*Read before the Royal Society of Queensland, December 14th,  
1907 ; and repeated April, 1908.*

## I. INTRODUCTORY AND EXPLANATORY.

1. From the time when the peculiarities of the fauna and flora of Australia began to be studied, it has been the universal belief that in Australia we have a unique example of an "arrested" continent, which, from long isolation, has preserved many of the features of bygone epochs, especially in its Marsupials. These are pointed out as survivals of the early forms of mammalian life which began, apparently, in Triassic times, and became important in the Jurassic.\* As the testimony is practically, indeed as far as I know quite, unanimous on this point, there is no necessity to quote evidence in proof.

2. Yet it is this well-established belief that I controvert ; and I think I can prove that Australia, instead of being the oldest of Continental areas, is in reality the newest. Our flora, unique both in character and distribution, and our fauna, unlike any other, have been evolved upon Australian land, within a very recent period, not dating back in time much beyond the Pliocene, and this colossal change was the direct result of geological alterations in the geography of the area, which brought about deterioration of climate.

3. Briefly, my theory is this. In Cretaceous times, and far into the Tertiary, there was no Australian Continent at all, but, instead, an Archipelago consisting of two main islands, one in the west, the other in the north and east, with a number of smaller islands in between. This, Dr. A. R. Wallace clearly demonstrated in his masterly "Island

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\* They seem to be missing in the Cretaceous.

Life," and so far our views march together. There was then free water communication right across what is now the middle of the continent; the islands were mountains, and the climate, in consequence, temperate to warm-temperate, equable, and the land bathed with plentiful rains.

4. At this time, and far onward into the Tertiary, neither the plants nor the animals differed much from those of other parts of the globe. The Tertiary flora, for example, was part of what V. Ettinghausen calls the "universal" flora, and might just as well have been called European or North American as Australian. There were, however, no land mammals, and this is most important, and has been overlooked. There is not a trace of any land mammal in any Australian rock older than Pliocene, and this in spite of the continued labours of geologists in our richly fossiliferous, and wide-spread Tertiary deposits.\*

5. From the close of the Cretaceous onwards, upheaval was pretty continuous, until eventually the Australian Archipelago was converted into the Australian Continent. By this time, mammals had entered from Asia on the north-east, *via* New Guinea.

6. The immediate result of the upheaval was the cutting off of the water-supply from the central districts, and consequent elevation of the temperature—deterioration of climate had come in the train of enhanced area; Separation had given place to Federation, and the price paid was a heavy one. The old islands had been blessed with an equable, insular climate: they were like Celebes or Moluccas, but not so hot. The new land was, as now, hot and dry—it was semi-desert. Nor was the dryness of the central plains entirely due to diminished rainfall, for, as we shall see, they were robbed of much of the water which would normally have refreshed the soil, by peculiar conditions which turned the floods underground, only to be useful again as artesian water, eagerly, and expensively, sought after by deep borings.

7. Under those conditions the plants and animals had

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\* A single specimen has been recorded from Tasmania from doubtful older Tertiary rocks. It is, however, quite certain they must have been very rare; but the presence of a few forms does not affect my argument. The vast majority are of late Tertiary age.

either to accommodate themselves to the more strenuous conditions, or die. Many succumbed : but many conquered in the strife : and so we obtained at last a true indigeonous flora and fauna. It was an absolutely new state of things—the plants took on the remarkable semi-desert peculiarities which make them so interesting to the student of evolution, and most of the mammals acquired (or if you will, re-acquired) the marsupial habit.

8. It will be noticed that the cases of the flora and fauna are not quite parallel. It is true that the Tertiary flora of Australia only faintly prefigures the present flora : but this is the case everywhere, though in Australia we can say that the difference is greater than anywhere else.

9. But with our fauna it is different. So far as regards our Marsupials they are truly Australian : truly and entirely new developments. In no part of the world, recent or fossil, is anything analogous to them known. They are the real Australian Native—far more so than the Blackfellow, for he, after all is a man with like passions with ourselves.

It now remains for me to make good my claim.

## II. THE FACTORS IN THE PROBLEM.

### (a) *Orographical.*

10. The Australian Continent, compared with others, is unmarked by any great elevated areas ; only in three parts, all in the eastern coastal region, rising to above 5,000 feet. The greater portion is more or less undulating plain and table land lying between 500 and 2,000 feet. The major part of the west coast, the shores of the Gulf of Carpentaria, and a large portion of central southern Queensland and New South Wales, and extending south to the coast of eastern South Australia, are under 500 feet.

11. The eastern coast, from Cape York to Tasmania (which is geologically part of Australia) is mountainous, and in the central area the Macdonnell and a few other ranges rise to about 4,000 feet.

12. Australia is, therefore, a huge series of table lands and plains, with an elevated eastern rim, and a few scattered central high lands.

13. Speaking broadly, all the land above 2,000 feet is



of Palaeozoic or older Mesozoic age, and so are a great part of the less elevated (500 to 2,000 feet) regions of West Australia, and parts of South Australia and the Northern Territory.

14. The rest is covered with Cretaceous and Tertiary rocks, with wide areas of surface sandy material, which may be the waste of Tertiary or Cretaceous beds, or may be only of comparatively recent sub-aerial origin. Much of this district is practically virgin ground to the geologist, lying in West Australia and the Northern Territory.

(b) *Geological.*

15. The beds which chiefly concern us are the Cretaceous and Tertiary.

16. The accompanying map, kindly prepared for me by Mr. L. C. Green, late of the Geological Survey of Queensland, and now the able lecturer on Geology at the Brisbane Technical College, shows the lie of the Cretaceous and Tertiary beds as far as at present known. The Cretaceous boundary is pretty exact, over much of the area, but it must be remembered that a great deal of this formation lies hidden beneath the Tertiary strata.

17. The main point for our present purpose is that the Cretaceous beds cut Australia into two portions—a long, narrow, mountainous area on the east, and (if we include the area faintly hatched as once covered with Cretaceous rocks), a compact area of no great height on the south-west. There are also inliers of older rocks, which stood as islands in the sea.

18. Dr. A. R. Wallace saw this clearly, and the map in his "Island Life," might almost serve my purpose—my map is only truer from including evidence unknown at the time our great philosophical naturalist wrote his charming, and suggestive work.

19. For reasons that will appear, I shall call the entire area the Australian Archipelago, the eastern land-mass *Australia Orientalis*, the western land-mass *Australia Vera*, and the sea between the two Australias, the *Opal Sea*.

20. The whole of these Cretaceous beds are marine, and have yielded a rich harvest of fossils. They fall into two unconformable series, the Lower and Upper Cretaceous, whose sub-divisions and local names do not concern us.

21. The Lower Cretaceous are characterised by thick shales and sandstones, but the important division to us is a remarkable bed described and named by Dr. R. L. Jack, the Blythesdale Braystone, whose boundaries have been traced by my old colleagues, Dr. Jack and Mr. Gibb-Maitland, for hundreds of miles along the eastern flank of the Cretaceous area.

22. This Braystone, which is as porous as sponge, is the basement bed of the Lower Cretaceous, and being exposed by the excessive denudation of the overlying Desert Sandstone, it lies like a catchment-drain along the flanks of the highlands, and drains away the water which would otherwise flow as surface streams over the (in consequence) arid lands to the west. This is a most important factor in our argument.

23. Upon the gently sloping Lower Cretaceous beds, the Upper Cretaceous rocks have been laid down unconformably. Their important member is the Desert Sandstone, whose isolated patches cap the low hills and make them remarkably similar to the Koppies of the South African veldt. The Desert Sandstone marks a late stage in the shoaling of the Opal Sea, but it is most noticeable for our purpose from the great quantity of colloidal silica it contains.

24. It is this colloidal silica which has given to Queensland and New South Wales their treasures of Opal, and hence I call the waters in which the silica was dissolved the *Opal Sea*. Only a minute proportion of the colloidal silica has been converted into precious opal, the mass remaining in the normal form, much of it in the so-called Porcelainite.

25. The country around the Desert Sandstone koppies is strewn with flakes of this porcelainite, like shards upon the Euphrates' plains. But the material is not baked clay at all. It extends over some thousands of square miles, and many miles away from the basalts: moreover, our basalts have very little baking power—they scarcely modify even the lignite upon which they sometimes repose. Again, the rock is not aluminous, but consists almost entirely of an admixture of colloidal and crystalloidal silica.

26. I believe this so-called Porcelainite to owe its origin to the effect of solar heat upon the exposed material—that, in fact, it like the fauna and flora, is the product of

the deterioration of the climate consequent upon the death of the Opal Sea. The central portions of Australia were converted, in fact, into a huge sand-bath. This idea I have elaborated somewhat in my recent work, "The Story of the Noble Opal," and shall further develop in a forthcoming work on "The Origin of Australia." It suffices to point out that one may say scientifically as well as epigrammatically that the Opal and the Kangaroo have a common origin.

27. The Opal Sea must have been much like what its present representative, the Arafura Sea, is now—so shallow that it is rather submerged land than ocean. One can anchor anywhere between Australia and New Guinea, and there is no really deep water between there and Borneo or the mainland of Asia. But the Opal Sea was not obliterated by infilling of sediment—elevation had much to do with the process, which was not completed until Tertiary times, an additional reason why the term Cretaceous Sea is inappropriate. The elevation was most rapid in the north, so that at an early date the cooler southern waters were cut off from what is now Central Australia. The first union of Australia Orientalis with Australian Vera was to the north—and to this day, the continent, as a whole, slopes downwards north to south.

28. Of the Tertiaries it is only necessary to speak in general terms. They prove that elevation continued till Australia became a continent, and widely distant, land- and fresh-water deposits, from the extreme north to Tasmania, with beds in many places rich in plant remains, show how different the flora was from that which now occupies the area, and stranger still, prove that, as yet, no land mammal has reached even Australia Orientalis. What these geological conditions tell us of the old climate we must now proceed to unravel.

### III. THE CLIMATE OF THE AUSTRALIAN ARCHIPELAGO.

29. That the climate of the old Australian Archipelago must have been very different from the present arid conditions is almost self-evident. Picture the state of affairs. A long, narrow, mountain land in the west, singularly like

Java or Palawan, or one of the many of the lovely isles of the Indian Archipelago, stretched some 2000 miles from Cape York to Tasmania. Probably it was connected with New Guinea also. This was Australia Orientalis. On the other side of the Opal Sea to the west, a large compact island, like Borneo without its high mountains, which in all probability extended much further west than the present coast. This was Australia Vera. Between these were smaller islands, some quite mountainous. What climate must they have inevitably enjoyed?

30. Surely not an extreme one such as prevails now. In the first place there was a free mingling of warm waters from the north and cooler waters from the south, whose joint action was to ameliorate the heat. The waters of the Opal Sea flung their vapours upwards into cloud-wreaths, which shed their life-giving burdens upon the many islands—there could have been neither drought nor fervent heat, any more than is experienced in the sister islands of the Far East. The mountains were higher then than now, and there is distinct evidence that in Tertiary times snow and ice were not unfrequent even in the neighbourhood of Brisbane.

31. Nor is this a mere inference from orographica conditions. There is positive evidence in the plants and animals. The first piece of evidence is negative, and I may say it is almost too strongly in my favour—too perfect. I have great hesitation in inferring temperature from life-forms so far back in time as to the Cretaceous: but as the palæontological is backed by the physical evidence, I dare not omit it. In these waters of the Opal Sea of Cretaceous times no reef-building corals lived—they could not. It was not that the waters were too charged with sediment, for corals thrive in the preceding eras, and in the following Tertiary period. What a contrast to the Queensland coast of to-day, with its 1,200 mile long Barrier Reef! It certainly looks as if the waters of the Opal Sea were too cool to allow of such growth, and when we remember that there was free ingress from the Antarctic we may see therein at any rate a partial explanation. Still, I would not trust to this alone.

32. Far stronger is the story told by the Tertiary

flora. Throughout this long era Australia was clothed with vegetation in which the oak (*Quercus*), the beech (*Fagus*), the elm (*Ulmus*) and the willow (*Salix*), and many another plant known to the dweller in temperate Europe and North America, took important roles. The climate must have been favourable to them. That it changed for the worse is proven without possibility of mistake, by the fact that they succumbed as the climate grew hotter and drier, and are no longer to be found in our native woods. The predominating feature of our Australian forests (except the true scrub, of which more hereafter), is the sombre Eucalyptus, the leaf-starved, phylloid-bearing Wattle (*Acacia*), and the leafless Casuarina—it is a shadeless forest.

33. On the other hand, the Tertiary forest was like the Forest of Arden or the Böhmer Wald, or the woodlands of Canada and the United States, full of umbrageous trees. There could have been no monotonous and tantalisingly impenetrable Mulga Scrub of thick-set bushy Eucalyptus; none of the dread Malee Scrub of prickly dwarf *Acacia*; still less was there the heart-rending *Spinifex*, covering hundreds of miles at a stretch with fixed bayonets of *Triodia*. The plains of the old lands were flower-decked savannahs, its lagoons were overhung with tree and bush whose deciduous leaves still lie in the fine ripple-marked silts that mark the old sites. A greater contrast between then and now can hardly be imagined. The deterioration of the Australian climate is no fancy of the philosopher: it is a truth stamped upon the rocks for all to read that list.

#### IV. THE IMPERFECTION OF THE GEOLOGICAL RECORD.

34. In the days when Darwin and Lyell wrote, the imperfection of the geological record could always be appealed to when evidence was not forthcoming. Even to this day some writers look to it in support of their views, as if it were some holy thing, some sacred mystic formula and specific, to be used in every emergency, and accepted as final, and without comment. Yet it is only an expression of ignorance, and its weight diminishes with every new discovery.

35. A theory might be true, and yet there be so many gaps in the evidence that it was unprovable, and it was lawful to say, "Wait for more evidence: it is the imperfection of the geological record that is in fault, not the theory." But if the theory be sound, each new discovery will narrow the gaps: if unsound it will widen them. It cannot be claimed that this test has worked out satisfactorily for many of the pet side-shows of the theory of Evolution.

36. For instance: our knowledge of fossil mammalia has vastly increased of late years, and many minor gaps have been filled in. But the greater gaps are more gaping than ever. We know, for example, a great deal about the fossil pedigree of horses: but we are farther off than ever from knowing the ancestry of the Equidae. Still more remote seems any hope of perfecting the genealogical tree of the Mammalia. The old saw about Nature not moving by leaps seems to be losing its teeth.

37. When Wallace wrote his "Island Life" it was quite reasonable for him to hope, and write as if the future would reveal, the ancestors of our Marsupials in the rocks of Australia. The appeal to imperfection has lost its force to-day. We have explored the Australian and Tasmanian Tertiaries pretty completely, and found them very rich in plant remains. Yet have we never found a trace of any land mammal at all. True, this is negative evidence: but if such creatures did not exist, what other than negative evidence is possible? Surely the negative evidence of every fisherman who has speared, or netted, or angled for, or poisoned, or dynamited fish in the Brisbane River is good evidence of the non-existence of trout in the stream!

38. When we get to Pliocene times, Marsupial remains are plentiful enough, showing there was no difficulty about their preservation. The fact is that the Marsupial was not in Australia; and as none of his remains are found elsewhere, and as he has no living representative outside the Australian area, the only logical inference is that he is of Australian origin, and of recent date at that. But we shall have to say more on this point presently. The American opossums, we shall see, are out of court.

39. The conclusion forced upon me is that both our

flora and fauna are of recent origin, that the Marsupials are quite new and unique, and that both are the direct consequence of the deterioration of climate which took place when the separation of the Australian Archipelago was superseded by the federation of the Australian Continent.

#### V. THE IMPERFECTION OF *THIS* RECORD.

40. This paper can only be a sketch of the evidence and of the conclusions at which I have arrived. The details are so numerous and voluminous that it will require a volume to set them forth, and this volume I shall undertake at once.

41. So much it is necessary to indicate, lest the reader imagine that because I deal chiefly with the Flora and Mammalia, I have not taken account of the evidence, for and against, which is deducible from the study of other forms of life.

42. In my forthcoming work I shall also deal with the views of other authors. There is not much to controvert. My explanation is mainly a constructive one, and only destructive on points of minor importance—points which do not affect the main conclusion—points which have always been felt to be difficulties.

#### VI. THE EXISTING AUSTRALIAN FLORA.

43. We are indebted to Sir J. D. Hooker for the first comprehensive view of the flora of Australia, and the long years that have passed since the masterly essay "On the Flora of Australia" was published in 1859, have not materially altered the views therein set forth.

44. There are several ways of looking at a flora, each in its way instructive, a few of which we will glance at, leaving particulars for my larger work.

45. There are some 10,000 known species of plants indigenous to Australia. They may be divided into Tropical and Temperate, and whereas elsewhere the tropical is always richer in species than the temperate flora, the reverse is the case in Australia, for over 6,000 species out of 10,000 belong to the temperate group. This in itself is sufficiently remarkable, but its significance only becomes clear when

we find that by far the greater number of the temperate forms are confined to a comparatively small area in Western Australia. Two-fifths of the genera and seven-eighths of the species are altogether confined to it. To this flora alone can the term Australian be accurately ascribed. It has spread, with modifications, all over the rest of the continent, but is there so altered, and so whelmed in the tropical flora, that it is quite subordinate. My friend, Mr. Cyril White, of the Botanic Department, Brisbane (who is himself unique as being of the fourth generation of botanists, his great-grandfather having been the first Australian Government Botanist, as his grandfather is still the oldest) has kindly undertaken for me the arduous task of working out the distribution of the entire Australian flora. Much interesting matter has come to light in the course of this research, but it must be relegated to my further work. Only broad facts, and only a selection of these can be given.

46. How entirely distinct the Queensland flora is from the West Australian is evidenced by the fact that of the 4,474 species named in Bailey's "Queensland Flora" only 620, or less than 14 per cent., occur in West Australia.

47. But mere numerical statements convey but an inadequate conception of the difference between the so-called Extra-tropical and the Tropical floras. It is the general facies that is most striking, and I can best illustrate it by a personal reference. I came to Queensland after spending years in the primeval forests of the Far East, and my first introduction to Australian forests was in the scrub of North Queensland. To me it was a revelation and somewhat of a disappointment. I knew, so far as the books and specimens can teach, what the peculiarities of the Australian flora were, but this Atherton scrub, this wild tangle of the Barron Gorge, was not Australian at all. It was the pure Asiatic "utan rimabau"—the deep forest—I had left in Borneo. The same tall trees with broad shade-giving leaves, the same climbing "rotan" (*Calamus*), and even the insects, gaudy *Ornithopteras* and royal purple *Eupleas*, met me on every hand. It all looked familiar. Some years afterwards, when I had grown accustomed to this flora, I entered W. Australia for the first time, landing



at Albany from S. Africa. What a revelation it was! At last I saw Australia-Vera: at last I was in a new and strange land: at last I knew and realised what I had only imagined I knew before. It is this great contrast that must be borne in mind.

48. I would rather substitute the terms *Oriental* and *Eu-Australian* for the two floras—the one is only tropical in that it is allied to that of tropical Asia, the other only temperate or extra-tropical because it is best marked in the West, which itself can only be called temperate geographically and euphemistically. The Oriental flora is more Asiatic in general aspect than in number of species actually common to Australia and Asia—there are about 620 flowering plants and 200 ferns specifically identical in the two areas. As might be expected, the most truly Asiatic part of Australia is the northern-coast line, the richest part of this is the region adjacent to Cape York peninsula, and the Asiatic plants have not crept far down the north-west coast. It is highly significant, too, that the aquatic Dugong and the aerial Fruit-bat or Flying Fox (*Pteropus*) have the same restrained limit westwards, though the former goes south along the east coast to Moreton Bay, and the latter as far as Tasmania.

49. No other portion of the world has such a remarkably differentiated flora. Not merely in the distribution of its species, but in the characters of the true Australian forms, which are profoundly modified to adapt them to the semi-arid conditions which now characterise the major part of Australia.

## VII. THE FOSSIL FLORA.

50. Australia and Tasmania are rich in Tertiary deposits, and they have yielded a very rich harvest of plant remains, so that the imperfection of the geological record cannot be applied in this particular instance. We have ample evidence upon which to found a correct estimate of the nature of the Tertiary Flora of Australia. And as New Zealand, on the one hand, and Borneo, Java and Sumatra on the other, have yielded equally rich data, we have plenty of evidence as to the nature of the vegetation in the ages which preceded our own. True, we are not

always able to subdivide our Tertiary deposits with the minute accuracy attainable in Europe, and indeed in some cases it is still a moot point as to whether certain beds should not be relegated to the Upper Cretaceous. But, as a rule, it is not difficult to discriminate between Older and Newer Tertiary (*Eocene* and *Neogene*), and as a matter of fact this has only a subsidiary interest in our research. Suffice it that we can draw a fairly accurate picture of the Tertiary Flora.

51. When Wallace wrote his "Island Life," most of this evidence was unknown to him—much of it had not been published. It is chiefly to the researches of Messrs. R. M. Johnston and H. Dean, in our hemisphere, and the Baron v. Ettinghausen in Europe, that our knowledge has become so complete, but many others have made valuable contributions.

52. Let us glance at this Tertiary flora, as represented from the Arctic regions to New Zealand, in all latitudes and all climates. The first thing that strikes us is the singular sameness of it all: singular not merely in possessing so many closely allied forms, but in being everywhere so utterly distinct from the flora of the present time. We look upon our Eucalypts, our Grevilleas and our Banksias, as strikingly Australian: but they had their representatives in Tertiary Europe and America. The oak, the beech, the elm, and the willow, are to us symbols of the woods and copses of the great Nearctic Region, yet they formed no inconsiderable proportion of the Tertiary flora of Australia. Even if we examine the Tertiary plants of such purely tropical places as Borneo, Java and Sumatra, we find it far less "tropical" than now, indeed, if we judge of climate by the plant remains we should hardly have guessed that these beds belonged to islands that are literally threaded upon the Equator. The Tertiary flora of the whole world was more uniform than now: and v. Ettinghausen has designated this the Universal Tertiary Flora.

53. That eminent authority thus sums up the case. "The Tertiary Flora of extra-tropical Australia (he might have included tropical also—S.B.J.S.) is as regards character, essentially distinct from the present living flora of Australia: nor does it closely resemble, in general, any other

living flora. On the other hand, it shows the mixed character of the Tertiary Floras in Europe, the Arctic Regions, North America, and probably all the Tertiary Floras. It has also much more similarity to the Tertiary Floras at present known than to the existing flora of Australia. *The characteristic plants of Australia are but feebly represented."*

54. Space will not permit of details: for this my forthcoming book must be consulted. But this last conclusion, which I have italicised, enables us to put the botanical problem as never before. How comes it (1) that the present Flora is so utterly different from the Tertiary flora, and (2) how comes it that the feeblest part of the Australian Tertiary Flora has developed into the rich and unique Flora of the present? An answer will be given in the sequel.

### VIII. THE PRESENT FAUNA.

55. It is chiefly upon the fauna of Australia that the idea has been founded that ours is an arrested continent, in which owing to long isolation, and consequent immunity from competition, have been preserved forms of life that elsewhere have succumbed or become modified in the struggle for existence. Among molluscs our Brachiopods, among fishes our *Ceratodus* and *Cestraceon*, for example, and above all our Marsupials are pointed to as lingering strains of the Mesozoic age—and in the pretty, banded, *Myrmecobius* we are asked to see the echo of the *Microlestes* that wandered by the waterside in old England when the *Oolites* were forming. No one ever seems to have doubted this, yet I believe I shall prove it to be an entirely erroneous assumption.

56. I cannot stop to work out the whole of our fauna. That must be recorded elsewhere. But as our Marsupials afford the strongest argument for the prevailing opinion, we will take them as a test. The assumption is based upon the fact that in Triassic and Jurassic times the only known mammals were small creatures which have been placed among the Marsupialia. Also that the aplacental character of these mammals shows that they are of very low—indeed the lowest—type of mammal. Let us see how far these assumptions are borne out by facts.

56. The essential feature of the Marsupialia is, of course, their aplacental development, and this clearly cannot be determined from fossil remains. Hence the marsupial affinities of fossil forms are inferred from certain peculiarities of the hard parts, which are alone preserved. Of these the most important are (1) a peculiar inflection of the jaw; (2) the character of the teeth; and (3) the presence of the so-called pubic bones. As a matter of fact the remains of pubic bones have never been found fossil in Mesozoic forms, and as this is the only certain proof of marsupial character, some doubt must always remain. Still, it may be admitted without damage to my argument that the Mesozoic forms were truly aplacental.

57. The modern Marsupialia are generally placed in two divisions—the *Diprotodonta*, with two prominent front teeth, and the *Polyprotodonta*, with many front teeth. The diprotodont forms are peculiar to Australia, none living elsewhere, and none having been found fossil outside Australia. True, an interesting series of forms have been recently disinterred from the Patagonian Tertiaries which were looked upon as possible ancestral forms of the Australian Marsupialia. But they turn out not to be Marsupial at all, their teeth being quite different in structure, and no pubic bones having been found, in spite of the fairly complete skeletons exhumed, they may be left out of our consideration. They seem rather to be Creodonts.

58. Outside the Australian Region the only living marsupials are the Opossums (*Didelphys*) of S. and N. America. They belong to the Polyprotodont division and their fossil remains are found in the Lower Tertiaries (Eocene) of Europe and N. America, but only in late Pliocene in S. America. None occur in the rich deposits of the Himalayas or Egypt. They certainly did not reach America via Australia, but most probably via northern Europe. They have no Australian representatives, the so-called Australian opossums being diprotodont. In Australia the Polyprotodonts are represented by several genera and species, but the mass of our Marsupials belong to the diprotodont division.

59. Now comes the important, and most singular fact in the distribution of the Diprotodont Marsupials. They

are exclusively Australian, none passing beyond the limit<sup>s</sup> of the zoological region, nearly all of them confined to the continent itself and to Tasmania, and none reaching New Zealand. Not only are they thus strictly limited, but *not a single fossil mammal of any kind is found in any Australian deposit older than the Pliocene*. No such anomaly as this is known elsewhere: yet it has been entirely overlooked, and the tacit, or expressed, belief has arisen that our Marsupial fauna, with its vast development of types, comparable with almost the entire series of orders of the Placentalia, have been gradually evolved from primitive types whose remains will be found in our older Tertiary or Secondary rocks. There is not the slightest evidence in support of such a view: it is a pure assumption, diametrically opposed to facts.

60. So far as geology teaches us, and there is no other basis for a sound judgment, the Australian Mammalia (except the Cetacae and Phocidae) *appeared on the Continent in late Tertiary times, developed into the peculiar Australian forms with great rapidity, rapidly culminated in gigantic forms, and began to wane as rapidly*.

61. It is generally overlooked that our Mammalian fauna contains a large number of placental species. Our veteran osteologist, Mr. De Vis, so far as I know, is the only zoologist who has insisted on this fact. Taking the whole Australian Region, and citing only the genera given by Wallace in his "Geographical Distribution of Animals," we find thirty-five genera, ranging from the Primates and including almost every existing order. The number of Australian genera is nineteen. The Australian Marsupials include thirteen genera of Polyprotodonts and twenty of Diprotodonts. There are no less than eighty-two species of placental land animals recorded in my friend Ogilby's Australian list. This is no mean proportion. It is quite unfair to look upon Australia as devoid of the so-called higher forms of mammal.

62. If we omit the Dugong and the Seals, as hardly land animals, and the Dingo, which was probably introduced by man (perhaps very early man), we find these placental mammals are confined to the two orders (*Chiroptera* and *Rodentia*), which are best fitted to cope with

strenuous conditions of climate, the bats from their powers of flight, and the mice and rats, which are not only capable of thriving on dry food, but can do with a minimum of water—indeed some never drink at all. This is surely significant.

63. As every zoologist admits, our Marsupials and Monotremes taken together, and still more if the latter are left out, are not comparable with the individual placental orders, but represent them in bulk. Thus we have carnivora represented by such forms as *Dasyurus*, our Native Cats, herbivora by all kinds from the kangaroos of the plains to the tree-wallaby of N. Queensland and New Guinea; rodents are represented by the wombat, edentata by *Myrmecobius*, and so we may go on. Indeed the Metatheria (to use Huxley's terms) are comparable rather with the Eutheria than with any Family or Order thereof.

64. This indicates immense modification, and as it has been an axiom of most evolutionists that species are of such slow growth that even a geological era may not be long enough to produce one, we find even such careful reasoners as Wallace writing, "As, however, no other form than that of the Didelphyidae occurs there (Europe) during the Tertiary period, we must suppose that it was at a far more remote epoch that the ancestral forms of all the other marsupials entered Australia." Now this is not so much explaining a difficulty, as explaining it away. It assumes as true the slow evolution of species, and argues from this assumption that our diprotodont marsupials must have had a very remote ancestry a long way off. As far as real evidence goes, the assumption is as baseless as the deduction. The rocks are full of evidence of rapid origin of species: the outburst of Ammonites in the Jurassic, the irruption of all sorts of mammals after the close of the Cretaceous—one can find any number of cases in point—and never one to show anything else but rapidity as to the origin of species.

65. The simple facts are, that the Australian marsupials *did* come on suddenly: they did *not* enter Australia in the dim Mesozoic ages: they *never did* live elsewhere. This is what geology asserts: the other is what geologists assume. We have, on strict examination of the facts, arrived at an impasse, just as we did in the case of the Flora. Surely

there is a way out, without assuming what the facts deny : surely the facts themselves are fertile in suggestion.

66. Certain other points about our marsupials must be cleared up. First : they are said to be the lowest type of mammal : then because the earliest known mammals are (thought) to be marsupials, they are claimed as ancestors of the Australian types. Neither of these deductions has much more evidence in its favour than the gratuitous one that species are parlous slow in achieving stability.

67. The term "low" as applied to specific form, is fraught with dire risk of misrepresentation. Take the "highest" living mammal—dog, horse, monkey, what you will—and deliberately consider whether it is better adapted to its environment, displays finer mental or physical powers, than our Marsupials. On this view the term is simply nonsensical—the ways of no marsupial have ever originated such an adjective as "sheepish" or "piggish," and no one ever thinks of calling a fool a wallaby instead of an ass—and yet these, forsooth, be all higher types than anything we can show ! It is not in physical or mental fitness that marsupials fall short.

68. But, says the systematist, it is in the mode of development that the marsupial comes short. Does it. Long ago, Sir R. Owen saw light in this darkness. He realised that in a land which was liable to periodic droughts, any mammal that brought forth its young, and cradled them in helplessness, would die out in the first long dry spell. The mother could not visit the distant water-holes and leave her helpless young behind. So, though Sir Richard had not the hardihood to put it so broadly, the mother kept her babies of portable size, built a pannier, and took the family about with her. Owen was laughed at : his shade may now begin to smile. Why, every bushman turns marsupial—only his pouch is his water-bag : being a man he is not so dependent upon the water-hole : he carries his water with him in his artificial marsupium.

69. The marsupial condition is eminently the best for the present Australian conditions—just as certainly as that it would not have been the best in the palmy days of the Opal Sea. Why should not our mammals have invented, or re-invented it ? I don't pronounce one way or the other : either

suits my purpose. You may derive our stock from the ancestors of the few that extend beyond the continent into the further islands of the Region, if you like—they are all polyprotodont, by the way, and so presumably of ancient lineage. But I confess they look more like emigrants from Australia, than laggards in the great stream of immigrants—and they seem sadly out of place in the moist forests I know so well.

70. But our diprotodonts—our very own mammals—they are certainly of the soil, and now that Prof. King has shown us that they were originally placental mammals after all—that in their embryonic state they still show traces of placentation—my contention seems to be gathering shape. It turns out, too, that the despised Monotremes, the lowest of the low—have rather taken a down grade than remained in stolid indifference to advancement—for the baby Platypus has genuine teeth. I do not call this degeneration: I call it the acme of wisely directed Adaptation. So light seems to be breaking on this dark spot at last.

71. Europeans and Americans have been handicapped by early geographical training: they have been so accustomed to hear Australia called an island, and to see it tucked into the right-hand bottom corner of the map of Asia, that they unconsciously miss its continental magnitude. All travellers I have encountered have been amazed at the size of the Sunda islands, startled to find it takes half-a-day's good steaming to run up the Gulf of Manila: and not one in a thousand realises that the Barrier Reef, which only spans part of Queensland's coast, if shifted into the hemisphere which calls the tune for evolutionists to play, would reach from London to Gibraltar, or from New York into Dakota. They still think of an island in the terms of Robinson Crusoe, and tell us Australia is too small, and so had not room for sufficient rivalry, to grow good placentals in her own soil. This view has always led to Australian problems being misunderstood. So let me say once and for all, that on the continent of Australia there is scope sufficient for the working out of any problem in distribution or specific development.



## IX. SOLUTION OF THE PROBLEM OF THE FLORA.

72. The solutions of the problems of our Flora and Fauna have, I trust, more than hinted themselves : but it is necessary to put the answers in definite language. The first question is, how comes it that the Australian Tertiary flora is so different from the present one ?

73. The reply to this should now be quite plain. At the close of the Cretaceous period, and far on into the Tertiary, the entire world-flora was less differentiated than at present, and Australia presented no peculiarity in this respect. That there was no great distinction between the floras of the east and west, is proved by the character of the fossil plants found in W. Australia, Victoria, N. S. Wales, Tasmania and Queensland.

74. Nor is this uniformity peculiar to the Tertiary flora. It becomes more evident, as our knowledge increases, that only in recent times—say from the Pliocene—has there been that great difference between the animals and plants which distinguishes one part of the world from another. In simple parlance, there was less of “the foreign” than now—the Palaeozoic and Mesozoic traveller would not have had the zest of fresh fields and pastures new (quotation dubious) for to him the molluscs and fishes, the crustacea and the reptiles, of the antipodes would have looked like home products. This great feature of general uniformity has not been sufficiently appreciated, and thanks are due to Mr. R. M. Johnston, of Tasmania, for insisting on its recognition. We are so accustomed to the idea that other places have other ways that we read the proverb *autres temps autres mœurs* back into geology, where it doesn't belong. There is something almost uncanny in crossing Europe and Asia amid the changing life, and dropping again upon most of the old English birds and butterflies in Japan, half round the globe : but it would not have excited a comment had we travelled with a Cretaceous Cook. So there is really nothing to explain as to why the Tertiary flora is so different from the present one.

75. The converse, why is the Australian present flora so much *more* different from the Tertiary than the floras of other places, is the true problem to solve. The answer is

that through the long Tertiary period the climate of Australia was deteriorating. The old universal flora had all the makings of the new flora in it—both the *Orientalis* and the *Vera* types—but when at last the Opal Sea became dry, only certain plants had adaptability enough to battle with the increasing heat and decreasing moisture. The rest died.

76. But there was a great difference between *Australia-Orientalis* and *Australia-Vera*. The former, owing to its mountainous and coastal character suffered less in climate—it has continued to receive fairly, and in parts quite, abundant rain and so a portion of the old flora has been preserved, in spite of its inferior adaptability. This is the so-called Tropical Flora which I prefer to call *Oriental*. It is as has been said, essentially *Asaitic* in facies, but the bulk is not specifically identical with the *Asiatic* flora—it is merely the tropical part of the Universal flora. This portion of our present flora, then, I look upon as a true survival.

77. Again *Australia-Orientalis* is still closely connected with New Guinea, and undoubtedly, was recently in direct physical continuity therewith. Hence there has been a real *Asiatic* immigration, And it is going on still.

78. I may remark, *en passant*, that it is considered as established that species become more vigorous, more able to cope with diverse conditions as they grow older—of course up to a certain age. Now if my contention be true, that our Flora as a whole is of modern date, the species should have comparatively small power of waging successful war against the sturdier denizens of botanically older lands. I do not lay much stress upon this, but we have learned to our cost, *e.g.*, in the Prickly Pear and Water Hyacinth (*Eichornia speciosa*), how alarmingly rapid is the spread of certain foreign species, and it is stated that no Australian introduced species has anywhere run riotously wild. If there is any truth in this, it tells in my favour. But I have seen *Mimosa pudica* and *Lantana*, both *S. American* forms, as is the Water Hyacinth, do just as much damage in places like Borneo and the Malay States, where the flora is assuredly as old as any. Also I do not know that any Australian plants likely to riot have been introduced into the northern warm-temperate zone, and garden flowers

assuredly have not established themselves, even in the rare cases in which they have become "escapees." I fear this is a bruised reed.

79. A point which will also appear in considering the distribution of our fauna is that if the true immigrant Asiatic plants are really of modern introduction, as compared with Oriental (tropical), we should expect not only to find them few in number, but gathered most richly about Cape York, and extending along the northern coast, and this is precisely what we do find.

80. The consideration of other features of the flora, such as the strange stream of northern-hemisphere sub-arctic plants that has so fascinated botanists and geologists, and the traces of Antarctic, African and S. American forms, must be left for another place.

#### X. SOLUTION OF THE PROBLEM OF THE FAUNA.

81. It has already been pointed out that while the Flora of Australia has been, for the most part, derived from the universal Flora which covered the earth in Tertiary times, and that but a small portion has been derived directly by immigration from Asia, the *Fauna* has no connection whatever with the geological history of Australia earlier than late Tertiary times. It now remains to clinch this argument with supplemental data.

82. If this contention be true, then the present distribution of the species should show evidence of their place of origin, much as the Asiatic portion of the Flora has been shown to do.

83. No one has a wider personal knowledge of the range of Australian animals than my friend the venerable Director of the Brisbane Museum, Mr. De Vis, whose researches into the palaeontology of the Marsupialia are so well-known. He has no doubt upon the question, and unhesitatingly declares for N. Queensland as the entrance gate: so do I.

84. Theoretically, on my view, we ought to find a very peculiar distribution. N. Queensland should be richest in species, and a rich stream, but of diminishing volume, should flow down the narrow area of ancient Australia-Orientalis from C. York to Tasmania. The broad land that was once Australia-Vera should show another, but less

rich culmination, and the intermediate, central area, the bed of the old Opal Sea, the newest and least rainy, should be meagrely blessed. This is actually the case.

85. Taking Ogilby's list, and supplementing it with Mr. B. H. Woodward's W. Australian list (Mr. O. Thomas' work unfortunately is not available in Queensland), the numbers as we travel along Australia-Orientalis from north to south are :—Queensland, 50 ; N. S. Wales, 43 ; Victoria, 35 ; Tasmania, 30.

86. If we travel east and west, from A. Orientalis, through the intermediate N. Territory and S. Australia to Australia-Vera in W. Australia, we find exactly the rise and fall in numbers the theory demands :—Queensland, 50 ; S. Australia, 32 ; N. Territory, 14 ; W. Australia, 38.

87. The W. Australian fauna has lately been studied most carefully, while the N. Territory is not so well worked, but though the numbers of species may need modifying, the relative proportions will remain as at present. My argument does not depend upon mere arithmetical accuracy: it is work for the actuary, not for the clerk.

88. The Bats and Rodents do not help us: they can get almost anywhere. Yet it is significant that the most highly modified bat, the Flying Foxes (*Pteropus*) are confined to Australia-Orientalis. W. Australia is in dread of their advent, and has by proclamation (1895) prohibited, "the introduction of Flying Squirrels, otherwise known as Flying Foxes, into the State." The Dugong is another case. Like the *Pteropus*, it might have been expected to have travelled far and wide—the ocean of water is as readily ploughed as the ocean of air, and both are abundantly victualled—yet it, too, is confined to Australis-Orientalis, never getting on to the west or even the north-west coast.

89. All this points conclusively to an Asiatic origin for our mammals, and no one seems to doubt the fact. But such a view is diametrically opposed to the descent of our fauna from a very ancient Australian ancestry: and is quite in harmony with my view of recent introduction. The crucial point is that there are no remains of land mammals in any of our pre-Pliocene rocks.

90. Whence then, came our Diprotodonts? Well, there is another curious superstition rife among many

evolutionists, who seem to think every plant and animal must, like Ahaseurus, come from somewhere else. Even the poor Englishman used to be chased up into the Pamirs and called an Undivided Aryan : and Australia, being an island, could not possibly be allowed to score off her own bat. Yet why shouldn't she ?

91. I take it that, as the geological evidence shows, in or about Pliocene times, Australia-Orientalis was again in land connection with Asia, *via* New Guinea (and perhaps Timor), and received plants and animals by that route. For the terrestrial mammals there was a vast new field, with no competitors save inoffensive lizards. It was an ideal land for the undisputed display of evolutionary force. But the new land was being converted into a veritable sand-bath, and though vegetation was plentiful, water was scarce and getting daily more capricious in its distribution, and being drained away by the Braystone.

92. The immigrants had to adapt themselves to the strange conditions, or perish. Doubtless many succumbed. The remainder became modified, and thrived amazingly—and I believe the Diprotodont type was then evolved. Animal life literally ran riot, as is evidenced by the colossal and bizarre remains of these primeval marsupials. But, as in every other case where there has been a sudden development, they overshot the mark. The giants could not hold their own, and speedily died out, leaving only our Old Man Kangaroo, to suggest his Titan forbears.

93. Whether all the immigrants were placental and acquired marsupial habits, or whether some were already polyprotodont aplacentals, future research must determine. I incline to think both forms arrived, but hold the opinion very feebly, for there is weighty argument for the small marsupials which live in the extra-continental portions of the Region being rather gifts from "Marsupialia," than that they are the Trigonias and Lingulellas of the Class Mammalia.

94. The gap between the placentals and aplacentals is being rapidly closed in : and not as the Darwinian expected by making them the lowly promise of higher forms, but by placing them on an independent and co-equal base, as the latest of the new, and not the last of the old covenant.

It may be, too, that Huxley saw dimly the connection between the types when he pointed to certain abdominal ligaments in the dogs as possible homologues of the marsupial bones. But if the *Metatheira* have thus been rescued from a false position, the still more lowly *Prototheria* have been as wonderfully rehabilitated. These purely Australia-Orientalian monotremes are no survivals of the almost batrachian type, but highly modified descendants of true toothed forms. And they as yet have not reached Australia-Vera.

95. The palaeontological record, from the Cambrian upwards teems with denials of the shibboleth that *Natura non fecit per saltum*. Giant strides are a favourite pastime of hers: her cycles are not geared to one speed. She can linger over a form for ages, or expend her energy in outbursts of creative vigour. We thought, as we never saw her in her sportive mood, that she was coy or resting awhile. But De Vries has shown us it was not the restful sleep of Nature that lay upon the world, but that the darkness and the silence were in ourselves—our eyes were filmed: our ears had waxed dull. Species, true physiological species, and not mere morphological varieties are coming into daily existence. Darwin's artificial pigeons needed the strictest isolation, or intercrossing would blot them out: De Vries *Aenotheras* are free to all the winds that blow, and all the bees that gather pollen, and remain true to type, for they are barren to their unregenerate relations. We must begin *de novo*, almost, and read the story of Evolution by the daylight of facts, and put by as childish the poor torchlight of unsupported imagination.

## XI. CERTAIN SIDE-ISSUES.

96. There are certain side-issues, of great importance, that space prevents me from dwelling upon. I hope to deal with them in a special work. Thus I have been, perforce, obliged to confine my remarks to the Australian Continent in its present delimitations. But Australian throes are not ring-fenced like her policy: they are world-wide in their significance. Australia did not spring adult and armed from any chaos. She is part and parcel of the planet, and has waxed and waned as its lands and seas

have grown and diminished. She was once farstretched westwards into the Indian Ocean. The depths of her west coast are but of yesterday—the movement is still going on. And she is connected with the upheavals and depressions of the great islands of the Indian archipelago, with the building of the mighty Himalayas.

97. The islands, great and small, included within the Australian Region of zoology, are genetically connected with the Australian continent. And so is far-off New Zealand.

98. Moreover, Australasia has, in times past, been linked with Antarctica, with S. Africa, and with S. America—but all before the eras this paper treats of. These, and other matters of equal fascination, I am reluctantly compelled to pass by in silence—for the present.

## XII. CONCLUSIONS.

99. The conclusions I have arrived at, and I hope established, may be thrown into a few condensed paragraphs.

100. The views here set forth are an expansion of those propounded by Dr. A. R. Wallace in his "Island Life."

101. They differ fundamentally therefrom in recognising that the present Flora and Fauna are the result of the obliteration of the Opal Sea, and the consequent alteration of the Australian climate. Also in deriving both the Tropical and Extra-tropical Floras from the Tertiary universal Flora, and in allowing only a small proportion as true Asiatic immigrants. But chiefly in making all our land mammals to be late Tertiary forms; not derived from pre-existing Australian forms, but entirely new species evolved to meet the new climatic conditions. The course of events was as follows:—

102. In Cretaceous times Australia was an archipelago, consisting of Australia-Orientalis on the east, a long mountainous island: of Australia-Vera to the south-west, with extension westwards beyond the present coast: and an intermediate island-studded sea, the Opal Sea.

103. At this time there were no land mammals, nor did any arrive till, in late Tertiary times, the Opal Sea was no more.

104. The climate was at first equable, mild, and the land copiously watered.

105. Steady elevation ensued, and went on through the Tertiary period, till the archipelago became the continent of Australia.

106. The climate rapidly deteriorated, and grew hot and dry, and the land became semi-desert, partly from diminished rainfall, partly from absorption by the Braystone.

107. Many of the original plants died out: the rest became profoundly modified. But as the old Australia-Orientalis suffered least climatic change, its plants retained more of their original character, and constitute the so-called Tropical or Asiatic flora. A small contingent of genuine Asiatic forms came across from Asia.

108. In late Tertiary times Australia was invaded by land mammals, mostly placental, with a few doubtful polyprotodont forms. The mass of the placentals developed aplacental characters and became our Diprotodonts, and perhaps, some became polyprotodont. The Bats and Rodents had no need to change, being sufficiently adaptable to thrive under the present climate.

109. Hence both our present Flora and Fauna are the direct result of the deterioration of climate consequent upon the obliteration of the Opal Sea. But whereas the Flora had a pre-existing basis to build upon, the land mammals were entirely new-comers. There being no competition, the rapid development of new types had every opportunity of taking place. The conditions were absolutely unique.

110. Hence, AUSTRALIA IS, IN REALITY, THE ONLY "NEW WORLD."

SYDNEY B. J. SKERTCHLY.



## DESCRIPTION OF PLATES.

## PLATE VI.—GEOLOGICAL.

In this plate the Cretaceous Beds are shown as exposed at the surface. They certainly underlie some of the dotted areas, and part of the Western Australian area marked Tertiary. How much of the sandy material of the Northern Territory and West Australia is of Tertiary age is not yet certain. The object of this map is simply to show how completely the Mesozoic and Tertiary Rocks cut the continent in two.

## PLATE VII.—PRE-CRETACEOUS AUSTRALIA.

This map is founded on Plate I, and shows the geographical conditions which must have obtained prior to the infilling and upheaval of the Opal Sea-bed. The coast line should have been continued to include Tasmania. The coast of Australia-Orientalis most certainly extended further eastward than shown, and that of Australia-Vera further westward, but I have confined the outline to the present limit of the Continent.

## PLATE VIII.—BOTANICAL.

This plate illustrates how completely isolated are the floras of the East and West, and how comparatively poor the central region is. The *Proteaceæ* were selected because they are a typical order of Australian plants, rich in genera and species, and not because they illustrate my theory better than other orders, or than the flora as a whole would do. Indeed the entire flora emphasises the peculiarity much more strongly than does any particular order of plants.

I have not made any scientific division of the continent, but if such divisions as those suggested by Prof. Baldwin Spencer were used, the facts would come out much more strongly. His Torresian largely coincides with my Orientalis, but he carries it along the Gulf coast, which belongs to the most recent instead of the most ancient part of Australia. This part of the Torresian area is characterised by true Asiatic species of plants—derived indeed from Asia.

The division of the Australian flora into Tropical and Extra-tropical, though real, obscures the facts of the origin of the plants. The Asiatic plants are all tropical, but then so are many of the true Australian plants, and the richness and wide-spread extent of the extra-tropical flora is simply due to the fact that in Tertiary times the only tropical habitat was in the northern portion of the narrow land of Australia Orientalis, while the greater part of Australia Vera, and the southern part of A-Orientalis (including Prof. Spencer's Bassian) was geographically extra-tropical and far wider in extent.

The following table gives the distribution of the whole of the Australian Proteaceæ:—

	W.A.	N.A.	S.A.	Q.	N.S.W.	V.	T.
Petrophila .. ..	33	0	1	4	3	0	0
Isopogon .. ..	25	0	2	2	4	1	2
Adenanthos .. ..	14	0	2	0	0	1	0
Simisia .. ..	5	0	0	0	0	0	0
Synaphea .. ..	8	0	0	0	0	0	0
Conospermum .. ..	27	2	1	2	7	3	1
Franklandia .. ..	2	0	0	0	0	0	0
Symphyonema .. ..	0	0	0	0	2	0	0
Bellendenia .. ..	0	0	0	0	0	0	1
Agastachys .. ..	0	0	0	0	0	0	1
Persoonia .. ..	24	1	1	11	32	8	2
Macadamia .. ..	0	0	0	3	1	1	0
Helicia .. ..	0	1	0	0	7	4	0
Roupala .. ..	0	0	0	0	1	0	0
Xylomelum .. ..	2	0	0	2	1	1	0
Lambertia .. ..	8	0	0	0	0	1	0
Orites .. ..	0	0	0	2	1	1	4
Kermadecia .. ..	0	0	0	1	0	0	0
Hicksbeachia .. ..	0	0	0	1	0	0	0
Strangaea .. ..	1	0	0	1	1	0	0
Grevillea .. ..	103	21	14	25	39	18	1
Hakea .. ..	73	7	10	18	14	11	6
Carnarvonia .. ..	0	0	0	1	0	0	0
Buckinghamia .. ..	0	0	0	1	0	0	0
Darlingia .. ..	0	0	0	1	0	0	0
Cardwellia .. ..	0	0	0	1	0	0	0
Stenocarpus .. ..	0	1	0	2	2	0	0
Lomatia .. ..	0	0	0	2	3	2	2
Embothrium .. ..	0	0	0	1	0	0	0
Telopea .. ..	0	0	0	0	1	1	1
Banksia .. ..	37	1	3	6	8	5	2
Dryandra .. ..	47	0	0	0	0	0	0

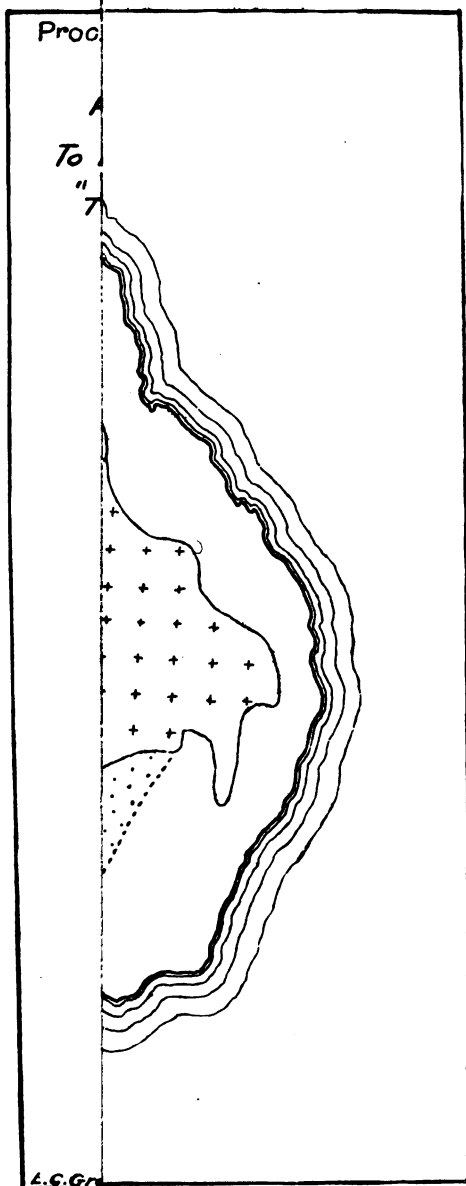
This list, though very remarkable, does not bring out the full force of the evidence; it does not show how few of the species are common to the West and East. I give below the range of the species of the genera, illustrated in Plate III:—

	Total.	Peculiar.	COMMON TO—			
			v.c.o.	v.c.	v.o.	c.o.
Petrophila .. ..	33	33	0	0	0	0
Isopogon .. ..	26	25	1	0	1	2
Adenanthos .. ..	15	13	0	1	0	1
Conospermum .. ..	27	25	0	0	1	2
Persoonia .. ..	25	25	0	0	0	2
Grevillea .. ..	103	99	5	4	1	13
Hakea .. ..	73	70	1	1	9	10
Banksia .. ..	37	37	0	0	0	2
Dryandra .. ..	47	47	0	0	0	0

v-Vera, c-Central, o-Orientalis.



Proc. Ro





# DESCRIPTIONS OF NEW QUEENSLAND FISHES.

By J. DOUGLAS OGILBY.

Read before the Royal Society of Queensland,  
December 14th, 1907.

IN the paper which I have the honor of presenting to your Society to night there will be found detailed descriptions of seven undescribed fishes from our coast, namely—1, the “slender dog-shark” (*Scoliodon jordani*) from the snapper banks outside Moreton Bay; 2, Howes’ needle-fish (*Tylosurus impotens*); 3, the “long-beaked gar-fish” (*Hemirhamphus welsbyi*); 4, the “sombre leather-jacket” (*Pseudomonacanthus melanoides*); 5, the “white-dotted grouper” (*Epinephelus raymondi*), from Moreton Bay; 6, the “small-toothed jew-perch” (*Pseudomycterus maccullochi*), from the Logan River; and 7, the “Queensland bellows-fish” (*Macrorhamphosus gallinago*) from the Tweed Heads.

In addition I have the pleasure of adding to the Australian fauna the showy clupeid known as the “lady-fish” (*Albula vulpes*), a fine specimen of which was captured along with sea mullet (*Mugil dobula*) at Southport on the 13th of June, and having fortunately come under the notice of my colleague, Mr. A. Raymond Jones, was purchased by him and presented to the Museum of the Amateur Fishermen’s Association. A few days later a much larger example was taken at the same place, but falling into a dealer’s hands was cut up and sold by the pound.

On the 26th of May, the members of the Brisbane Snapper Club were astonished to catch, on the large hooks and baits in use for snapper and kindred fishes, quite a number of mackerel (*Scomber australasicus*); this is the most northerly point at which this species has been obtained and forms a new record for Queensland. These shoals were

feeding at the bottom and were accompanied by droves of sharks (*Carcharias melanopterus*), numbers of which were captured.

From an examination of several specimens I find that de Vis' *Crossorhinus ornatus* is a valid species closely allied to *Orectolobus japonicus*, Regan. Its correct title is *Orectolobus ornatus*.

*SCOLIODON JORDANI* sp. nov.

*Slender Dog-shark.*

Body slender and subfusiform, its width  $\frac{7}{8}$  of its depth, which is  $10\frac{3}{4}$  in the total length. Head strongly depressed, its depth immediately in front of the gill-slits  $1\frac{4}{5}$  in its width, which is  $2\frac{1}{4}$  in its length. Length of head  $1\frac{3}{8}$  in that of the trunk and  $\frac{1}{5}$  of the total length. Snout produced and pointed, its length  $2\frac{4}{5}$  in that of the head. Space between the outer angles of the nostrils a little more than that between the inner angle and the tip of the snout, which is  $1\frac{5}{7}$  time its distance from the mouth; internasal space  $1\frac{1}{10}$  in the width of the mouth, which is but little ( $\frac{1}{6}$ ) more than its ramal length,  $\frac{5}{7}$  of the length of the snout, and  $3\frac{2}{3}$  in that of the head; tip of mandible rounded, not extending forward to the level of the anterior border of the eye; outer labial groove very short, directed outwards at a right angle to the jaw and  $\frac{1}{5}$  of the space between the eye and the mouth; no inner groove. Eye a little nearer to the first gill-slit than to the extremity of the snout, its longitudinal diameter  $\frac{1}{3}$  of the length of the head. Interorbital region convex, its width  $2\frac{9}{10}$  in the length of the head. Branchial region  $1\frac{7}{8}$  time the diameter of the eye; gill-slits narrow, the 5th  $\frac{5}{8}$  of the 1st and  $\frac{3}{4}$  of the 4th, which is the widest though not so wide as the eye. Length of head and trunk about  $1\frac{1}{10}$  in that of the tail. First dorsal fin inserted much nearer to the ventral than to the pectoral, its distance from the tip of the snout rather more than  $\frac{1}{3}$  of the total length; anterior border of fin undulose, its outer angle rather sharply rounded; outer border vertical in front, deeply emarginate behind, its posterior angle produced and acutely pointed, not quite reaching to the vertical from the origin of the ventral; length of hinder border rather less than half the base, which is  $1\frac{1}{3}$  in the vertical height of the

fin : second dorsal very small, inserted much nearer to the tip of the tail than to the origin of the first dorsal, the length of its base  $3\frac{1}{2}$  in that of the first dorsal and nearly  $\frac{1}{2}$  of the posterior border. Anal fin inserted much nearer to the caudal than to the ventral and wholly in front of the second dorsal, its posterior border much shorter than that of the second dorsal and a little less than the basal length, which is  $2\frac{2}{3}$  in its distance from the precaudal pit. Caudal fin long, its upper border  $1\frac{1}{10}$  time the length of the head and  $4\frac{1}{2}$  in the total length ; terminal border convex,  $2\frac{1}{2}$  times the lower border behind the notch, its upper angle acute ; descending lobe of lower border well developed and subfalciform, originating slightly in advance of the upper precaudal pit ; its anterior border  $2\frac{1}{4}$  in the space between its origin and the notch, which is  $1\frac{2}{3}$  time its distance from the origin of the anal. Pectoral fin moderate, extending when appressed to below the origin of the first dorsal, its anterior border linear, except at the extreme tip where it is bent downwards, its upper angle pointed ; outer border emarginate, the lower angle rounded ; posterior border sublinear ; width of fin from outer inferior angle to middle of anterior border  $\frac{2}{3}$  of its outer border. Ventral fin rather small, its origin  $\frac{1}{3}$  nearer to the anal than to the pectoral all the edges linear, the angles obtusely pointed. Dark ashy blue above, gray beneath : pectoral and ventral fins outwardly edged with ash-gray : iris white. (Named for Professor David Starr Jordan, of the Leland Stanford Junior University, in remembrance of his flying visits to Brisbane in May and June, 1907).

Described from an adult male, 860 millimeters in length, obtained on the outer Caloundra Bank in 25 fathoms on the 26th of May, 1907, by Mr. J. Daly, by whom it was presented to the A.F.A.Q. Museum ; Cat. No. 664.

### BELONIDÆ.

#### TYLOSURUS IMPOTENS, *sp. nov.*

##### *Howes' Needle-fish.*

D. 20 ; A. 19 or 20 ; P. 13. Body subfusiform, its depth equaling the distance between the preopercular border and the middle of the eye and from 14 to 15 in the length of the body. Width of head equal to its depth and rather



more than  $\frac{1}{2}$  of its length, which is  $\frac{1}{3}$  of that of the body. Postorbital portion of head  $2\frac{1}{2}$  in the preorbital portion which is  $4\frac{1}{2}$  in the length of the body. Jaws moderate and stout, the maxillary not entirely concealed when the mouth is closed; enlarged teeth strong but rather short; tongue ciliate. Upper surface of head with a wide and rather deep median groove; supraciliary and parietal regions partially striated. Diameter of eye  $1\frac{1}{2}$  in the interorbital width and  $2\frac{1}{2}$  in the postorbital portion of the head. Scales very small; cheeks and anterior half of cephalic groove scaly; opercles naked. Dorsal fin originating above the 4th or 5th anal ray, the height of the 2nd ray equal to its distance from the base of the 11th; posterior rays not produced; the last not reaching to the base of the caudal. Anal fin about as long as the dorsal, its anterior rays  $\frac{1}{2}$  longer than those of that fin and reaching to the base of its 14th ray. Caudal fin feebly emarginate, its lower lobe as long as the head behind the middle of the eye; caudal peduncle depressed, as wide as deep, with scarcely a trace of a lateral keel. Pectoral fin long and pointed, equal to the head behind the middle of the eye and  $8\frac{1}{2}$  to  $9\frac{1}{2}$  in the length of the body. Ventral fin inserted midway between the root of the caudal and the middle of the eye, not so long as the postorbital portion of the head, and  $12\frac{3}{4}$  in the body length. Dark green above, sides iridescent silvery, below white; dorsal and caudal fins dull green, with dusky borders; outer half of pectorals blackish; middle ventral rays yellowish: iris silvery, tinged above with pale yellow. (*impotens*, headstrong).

Type in the collection of the Amateur Fishermen's Association of Queensland.

Total length 800 millimeters.

Coast of Southern Queensland.

Howes' Needle-fish differs from *Tylosurus macleayanus* in the larger eye, the incomplete recession of the maxillary, the depth of the cephalic groove, and the shorter posterior dorsal rays; from *T. groeneri* in the depth of the cephalic groove, the smooth tongue, the broader peduncle, and the longer pectoral fin.

Described from two specimens, measuring respectively 540 and 580 millimeters, taken in Moreton Bay, and pre-

sented to the A.F.A.Q. Museum by Mr. Harry A. Howes ; Cat. No. 537.

The genus *Tylosurus* Cocco, may be conveniently subdivided as follows :—

**STENOCAULUS** : Body short and deep, strongly compressed, the caudal peduncle without a trace of a lateral keel.

Type — *Belone krefftii*, Günther. (στενός, narrow ; καυλός, a stalk).

**TYLOSURUS** : Body long, slender, and subcylindrical, the caudal peduncle without or with but a slight trace of a lateral keel. Type—*Tylosurus cantrainii* Cocco. τύλος, callus ; ὄψα, a tail).

**EURYOCAULUS** : Body short and broad, the caudal peduncle strongly depressed, with a wide sharp-edged lateral keel. Type—*Belone platyura* Bennett. (εὐρύς, wide ; καυλός, a stalk).

## EXOCETIDÆ.

**HEMIRHAMPHUS WELSBYI** *sp. nov.*

*Long-beaked Gar-fish.*

D. 13 ; A. 12 or 13 ; Sc. 50 to 52-6. Body robust, its width  $\frac{3}{4}$  of its depth, which is  $8\frac{1}{2}$  in its length. Length of head  $2\frac{3}{4}$ , of predental portion of the lower jaw, which is  $\frac{1}{2}$  longer than the rest of the head,  $4\frac{9}{10}$  in that of the body. Premaxillary plate wider than long. Diameter of eye equal to or a little less than the interorbital width and  $\frac{3}{4}$  of the postorbital portion of the head. Dorsal and anal fins scaleless, the former originating far in advance of and  $1\frac{3}{5}$  time the length of the latter ; last dorsal ray produced, not reaching to the base of the caudal. Caudal fin forked, the middle rays  $\frac{5}{8}$  of the diameter of the eye and  $4\frac{1}{2}$  in the lower lobe, which is  $5\frac{3}{5}$  in the length of the body and  $1\frac{1}{2}$  in the predental portion of the lower jaw. Pectoral fin with 12 rays as long as the head behind the angle of the mouth. Ventral inserted midway between the root of the caudal and the middle third of the pectoral, its length  $1\frac{1}{2}$  in that of the head from the tip of the premaxillary plate ; inner ray produced, not reaching to the vent. Back dark green ; sides with a conspicuous silvery band, which is widest below the dorsal fin, tapers towards either extremity, and is bordered above by a blue line ; lower parts

pearly white: anterior dorsal rays, outer and middle caudal rays, upper pectoral rays, and middle ventral rays dusky. (Named for Mr. Thomas Welsby, President of the Amateur Fishermen's Association, and an enthusiastic supporter of all scientific work connected with marine zoology).

Type in the collection of the Amateur Fishermen's Association of Queensland; Cat. No. 648.

Length to 400 millimeters.

Coast of Southern Queensland.

Described from eight examples, measuring from 280 to 400 millimeters, obtained in Moreton Bay during June, 1907, and presented to the Museum by Messrs. Thomas Welsby and Joseph Basile. They were very abundant until towards the close of the succeeding month, when they disappeared, and have not since been seen in our shops or market.

### MACRORHAMPHOSIDÆ.

#### MACRORHAMPHOSUS GALLINAGO *sp. nov.*

##### *Queensland Bellows-fish.*

D. iv 11; A. 16. Depth of body  $3\frac{1}{8}$  in its length,  $1\frac{1}{7}$  in the length of the head, and  $1\frac{9}{10}$  in the trunk and tail. Length of head  $2\frac{1}{8}$  in that of the body. Eye large, its diameter  $3\frac{1}{4}$  in the length of the snout and rather more than  $\frac{1}{8}$  of that of the head; snout  $3\frac{1}{2}$  in the length of the body. Interorbital region convex, its width  $\frac{3}{4}$  of the diameter of the eye. First transverse branch of the lateral line with its inferior portion very short and bent strongly forward so as to form an angle of about  $15^\circ$  with the horizontal branch. Second spine of first dorsal fin long, strong, and posteriorly serrated, extending backwards when depressed to the anterior fourth of the caudal fin, its height  $3\frac{1}{8}$  in the length of the body and  $1\frac{1}{8}$  in that of the trunk and tail; its origin is midway between the base of the middle caudal rays and the posterior border of the eye; soft dorsal fin acutely pointed, its base  $\frac{2}{3}$  of its height and  $\frac{2}{7}$  of the base of the low anal. Caudal emarginate,  $2\frac{1}{8}$  in the length of the snout. Pectoral fin pointed, with 14 rays, the upper the longest,  $\frac{1}{2}$  of the snout. Brick red above; cheeks, opercles,

and abdominal region violet bronze ; middle of sides silvery : fins yellow : iris silvery (*gallinago*, a snipe).

Type in the collection of the Amateur Fishermen's Association of Queensland.

Total length 123 millimeters.

Described from a fine specimen obtained at the Tweed Heads by Mr. Dallas Beal, in May, 1907, and kindly presented by him to the Association's Museum.

This species is certainly distinct from Waite's *Macrorhamphosus elevatus*, from which it may be distinguished by the fewer dorsal and anal rays ; the more elongate body, the shorter second dorsal spine, which originates much more anteriorly than in southern specimens, in which—according to Waite's figure—the origin is equidistant from the eye and the tip of the middle caudal rays, etc.

#### FAMILY SERRANIDÆ.

##### EPINEPHELUS RAYMONDI *sp. nov.*

##### *Dotted Grouper.*

D. xi 17 ; A. iii 9 ; Sc. 19-94-32. Depth of body  $2\frac{1}{4}$ , length of head  $2\frac{5}{7}$  in the length of the body. Snout  $\frac{1}{7}$  longer than the diameter of the eye, which is  $4\frac{2}{7}$  in the length of the head. Interorbital region feebly convex, its width  $7\frac{1}{2}$  in the head. Nostrils approximate, the anterior valvular. Lower jaw slightly projecting ; maxillary extending to below the posterior border of the eye, the width of its distal extremity rather more than half the diameter of the eye. Teeth in two series on each side of the mandible ; canines small. Vertical limb of preopercle convex, evenly and finely serrated, the angle rounded and armed superiorly with four stronger serræ, the lower limb entire ; opercular spines equidistant, the lower much further back than the upper ; opercular flap obtusely pointed, its upper border linear. Scales mostly ciliated, those of the head (except the opercle), the nape and a gradually narrowing area of the back from an eye's width behind the opercular flap to the base of the 8th dorsal spine, and the pectoral and thoracic regions deeply imbedded. Gill-rakers 12 on the lower branch of the anterior arch, the longest  $\frac{3}{4}$  of the diameter of the eye. Dorsal fin originating a little in advance of the base of the pectoral

(above the base of the middle opercular spine); 4th, 5th and 6th rays highest,  $\frac{3}{4}$  of the length of the head and as high as the middle soft rays; last spine shorter than the penultimate,  $\frac{3}{10}$  of the head. 2nd anal spine a little higher than the 3rd,  $2\frac{2}{3}$  in the length of the head. Caudal fin rounded,  $\frac{1}{4}$  of the length of the body. Pectoral rounded, with 17 rays,  $\frac{3}{4}$  of the length of the head. Ventral much shorter than the pectoral, reaching to the vent, its length  $1\frac{5}{8}$  in that of the head. Pale lilac, each scale of the body and opercles with a central white dot; body with a series of dark blotches which form six irregular bands running obliquely forward from the dorsal profile: soft dorsal and anal fins lilac with a broad purplish basal band; caudal tipped with purple; pectoral with a reddish brown basal spot; ventral marbled light and dark lilac. (Named for my friend and colleague, Mr. Audrey Raymond Jones, without whose hearty cooperation I would have found it well nigh impossible to carry out successfully my multifarious duties to the Association).

Type in the collection of the Amateur Fishermen's Association of Queensland; Cat. No. 678.

Total length 203 millimeters.

Coast of Southern Queensland.

Described from a specimen captured by Mr. C. Dahl at Cape Moreton, in May, 1907, and presented by him to the Association's Museum.

## SCIÆNIDÆ.

### PSEUDOMYCTERUS *gen. nov.*

Body elliptical, strongly compressed dorsally. Scales rather large, adherent, ciliated, with a wide spinulose submarginal band. Lateral line complete, extending on the proximal half of the caudal fin, the tubes straight with a single pair of predistal opposing tubules, not reaching to the border of the scale. Head rather small, scaly except the anterior half of the snout and preorbitals. Mouth inferior, the snout obtuse, projecting well beyond the upper jaw and bearing on its antero-inferior margin four short broad papilliform processes, which separate and conceal five large pores; maxillary entirely concealed beneath

the preorbital when the mouth is closed ; lower jaw included ; a large open mental pore. Jaws with a band of minute teeth ; no enlarged teeth ; vomer, palatines, pterygoids, and tongue toothless. Nostrils separate, the posterior the larger, rounded, semivalvular, and approximate to the orbit. Eyes of moderate size, mostly anterior and supero-lateral. Preorbital deep and entire ; vertical limb of preopercle with a narrow, crenulated, membranaceous border ; opercle with a short spine. Two dorsal fins, connected at the base, with x, i 29 rays, the spinous portion much shorter and higher than the soft, its rays flexible : anal fin short with ii 7 rays, the second spinous ray strong ; vertical fins with a low basal scaly sheath, and a series of small scales behind each soft ray : caudal fin large and cuneate, mostly scaly : pectoral fin well developed, asymmetrical, with 18 rays, the upper middle ones the longest : ventrals inserted behind the base of the pectorals, close together, with i 5 rays, the first soft ray the longest and terminating in a filament. Gill-openings wide ; gill-membranes separate, free from the isthmus ; seven branchiostegals ; pseudobranchiæ well developed ; gills four, a slit behind the fourth ; gill-rakers short and spinulose ; first, second, and fourth upper pharyngeals armed with small sharp teeth, the inner row of which is somewhat enlarged ; third pharyngeal enlarged, with strong conical teeth ; lower pharyngeals separate, with five series of teeth, the inner strong, the others gradually diminishing in size. Air bladder large, without lateral fringes, expanded in front, pointed and extending well beyond the vent behind. Stomach siphonal ; seven short pyloric appendages ; intestine with two convolutions. (*ψῦδος*, false ; *μύκτις*, nostril ; the anterior nasal flaps and pores having the appearance of supplementary nostrils).

#### Coast of Queensland.

In the feebleness of its dentition this genus differs from all the other Australian sciænids, and approaches the American genus *Leiostomus*,\* from which, however, it may be distinguished by the permanency of the mandibular teeth, the shorter anal fin, the cuneate caudal, and the acute lower pharyngeal teeth.

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\* Lacépède, Poiss., iv., p. 439, 1802.

*PSEUDOMYCTERUS MACCULLOCHI* *sp. nov.**Small-toothed Jew-fish.*

D. x, i 29; A. ii 7. Sc. 7—58—14; L. l. 46. Dorsal profile much more arched than the ventral; depth of body  $3\frac{1}{4}$  in its length. Upper profile of head obliquely linear, its length  $3\frac{1}{2}$  in that of the body. Snout obtuse and overhanging, rounded above,  $\frac{1}{3}$  more than the diameter of the eye, which is  $4\frac{1}{3}$  in the length of the head. Interorbital region convex, its width  $3\frac{2}{3}$  in the head. Maxillary extending to below the middle of the eye, the width of its distal extremity  $2\frac{1}{2}$  in the diameter of the eye. Depth of preorbital  $1\frac{2}{7}$  in the eye. Second dorsal spine highest,  $1\frac{2}{3}$  in the length of the head, and  $1\frac{1}{2}$  time the height of the soft dorsal. Anal fin originating below the 13th dorsal ray, its 2nd spine of moderate length,  $1\frac{1}{5}$  time that of the snout, and  $1\frac{1}{2}$  in the 1st ray, which is much lower than the spinous dorsal. Caudal fin  $3\frac{3}{4}$  in the length of the body; least depth of peduncle about 3 in the depth of the body and equaling the 2nd anal spine. Pectoral fin with 18 rays, reaching to the 12th scale of the lateral line, and  $4\frac{1}{2}$  in the length of the body. Ventral fin not quite so long as the pectoral, extending midway between its origin and the base of the 4th anal ray. Gill-rakers 5 + 10, the longest about  $\frac{1}{3}$  of the diameter of the eye. Silvery, everywhere so clouded with densely packed brown spots as quite to obscure the ground-color: vertical fins darker than the body, except the base of the spinous dorsal, which is dull blue. (Named for Allan Riverston McCulloch, a rising young Australian biologist).

Type in the collection of the Amateur Fishermen's Association of Queensland.

Total length 285 millimeters.

Described from a specimen caught in September last in the Logan River by Mr. C. Harris, and presented by him to the Association's Museum.

On being shown the fish, Mr. W. Nicklin states that to the best of his belief it is the same species as was common in the Brisbane River many years ago, and suddenly disappeared. The same habit has also been noticed in the now common "perch" of our fishermen, which, however, is a true *Sciæna*.

## MONACANTHIDÆ.

PSEUDOMONACANTHUS MELANOIDES *sp. nov.**Sombre Leather-jacket.*

D. 34; A. 29. Skin velvety, without distinct scales. Depth of body  $\frac{1}{2}$ , length of head (to upper angle of the gill-opening)  $\frac{1}{2}$  of the length of the body. Snout with the upper profile concave, its length  $3\frac{1}{2}$  in that of the body and more than thrice the diameter of the eye, which is  $\frac{1}{4}$  of the length of the head,  $\frac{5}{8}$  of the interorbital width, and is situated midway between the base of the dorsal spine and the upper angle of the gill-opening, and also between the tip of the snout and the first dorsal ray. Gill-opening below the posterior half of the eye, extending obliquely backward from in front of the upper angle of the pectoral, its length rather less than the diameter of the eye and equal to its distance from the eye. Dorsal spine originating above the middle of the eye, its height equaling the length of the snout, and rather less than its distance from the soft dorsal, which originates somewhat nearer to the tip of the snout than to that of the caudal fin: soft dorsal low and rounded, lower than the anal, the highest rays of which are  $\frac{1}{10}$  of the length of the head; the anal originates well behind but is conterminous with the soft dorsal. Caudal rounded,  $5\frac{1}{2}$  in the length of the body; caudal peduncle strongly compressed, its least depth  $\frac{1}{2}$  of the length of the snout. Pectoral short, with 12 rays, rather more than  $\frac{1}{2}$  the snout. Black, with a broad silvery band across the chin, midway between the tip of the mandible and the pectoral fin: soft dorsal, anal, and pectoral fins hyaline; caudal blackish (*melas*—from *μέλας*, gen. *μελανος*, black—an allied species; *εἶδος*, resemblance).

Type in the collection of the Amateur Fishermen's Association of Queensland.

Total length 71 millimeters.

Coast of Southern Queensland.

Described from a specimen obtained at Cape Moreton, in May 1907, by Mr. James Palmer of Bulwer, to whom the Association is indebted for it.

G—ROYAL SOC.



*Note on some fishes which fell during the thunder-storm on the 7th instant.*—On the 5th March, 1906\* I had the privilege of reading before this Society a note on the phenomena commonly known as "showers of fishes." In that note I showed that to my own knowledge two at least of our common creek forms were liable to be victims to these caprices of the elements, these being the "carp gudgeon" (*Carassiops compressus*) and the "firedail" (*Austrogobio galii*). I have now the pleasure of adding to these a third species, namely, the "trout gudgeon" (*Krefftius adspersus*). On the morning of Monday, October 7th, after the phenomenal hail- and thunder- storm of the preceding night, Mr. W. Adams, of Kelvin Grove, noticed numbers of these fishes lying dead in Victoria Park, which could have come to their untimely end by no other means. One circumstance, however, tends to exalt the present occurrence above the two which I have previously recorded, for whereas in those the specimens collected were small, measuring less than an inch and a half, and weighing but a few grains, in this case the larger of the pair secured by Mr. Adams, and kindly forwarded by him to the Amateur Fishermen's Association Museum, has a total length of 98 millimeters (close on 4 inches), and weighs 125 grains, or almost exactly half an ounce. That fishes of such a size and bulk could be whirled up into the air and carried along for a considerable distance shows the exceptionally violent character of that particular storm.

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\* Proc. Roy. Soc. Queensl., xx, 1906, p. 28.

# INSECTS AND DISEASE.

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**By Dr. A. JEFFERIS TURNER,**

**M.D., LOND., D.P.H., CAMB.**

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*A Paper read before the Royal Society of Queensland,  
on January 27th, 1908.*

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CASTING about for some topic on which to address you, it has occurred to me to chose for my subject the relationship between insects and disease, or insects as disease carriers. I must, however, disclaim any attempt to treat this subject in an exhaustive fashion. Of recent years, this department of science has grown too large to be adequately dealt with in my time-limit. Instead of attempting a bare summary of the whole ground, I think it will be more interesting and instructive to select two or three of the better-known instances and to consider them more thoroughly.

Insects may convey disease in two ways. Firstly, they may act as occasional bearers of disease-organisms, which may happen to adhere to the outside of their bodies. In this way they may become fortuitous carriers of diseases, which are by no means entirely dependent upon them for propagation, but whose spread may under favourable conditions, be greatly increased by insect agency. There is no doubt, for example, that the common housefly may be, and is, a disease carrier.

When the late Mr. Darwin was investigating the methods by which plants might be conveyed to oceanic islands, apart from human agency, it occurred to him to examine the legs of birds. He found that it was not uncommon for small particles of earth to be found adhering to their legs and feet, and that this earth sometimes contained seeds, which could germinate and produce plants.

So that birds migrating or blown from a continent and alighting on an oceanic island might carry with them the germs of plants. The case of the house-fly is analogous. Its tastes are unfortunately diverse. It appears equally fond of filth and fæcal matter on the one hand, and of food prepared for mankind on the other. That a fly alighting on any substance containing bacteria, and subsequently alighting on a suitable culture medium, will inoculate the latter with bacteria is easily understood, and has been frequently verified by experiment. The disease-organisms most likely to be conveyed by flies are those of typhoid fever, and of dysentery and other diarrhœal disorders. If a fly, which has visited material containing these organisms subsequently alights on some food material, such as milk, which is a suitable culture medium for the disease organism, this food will within a few hours, in warm weather, teem with the organism, and any susceptible person who imbibes it will probably contract the disease. Though this is not of course the only way in which typhoid and dysentery bacilli may reach food material, it is, I think, one of the commonest and most dangerous. Again, a fly alighting on an inflamed eye, will carry away with it pus organisms, which are implanted on the next eye which the fly visits, and so the fly may convey ophthalmia. This disease may, of course, be conveyed in other ways, but the fly is a most persistent and dangerous carrier.

What practical lessons may we draw from these facts in the way of prevention? The house-fly, we are informed by the entomologist, "runs through its life-history in a very short time. It lays about 150 very small eggs on dung, or any kind of soft damp filth; the larvae hatch in a day or two, and feed on the refuse; they may be full-grown in five or six days, and then pupating may in another week emerge as perfect flies." Consider what this means. Assume that  $\frac{1}{3}$  of the progeny of a female fly survive. In two weeks the solitary fly has become 100, of which we will suppose half are of each sex. In four weeks they are 5,000. In six weeks 250,000. In eight weeks, 12,500,000. We need not carry our calculation any further. Evidently a plague of flies is no miracle, and any direct assault on the insect by flypapers or otherwise in a very feeble palliative.

*If we want to keep down the numbers of the fly, we must keep down the food material of its larva.* We must do our own sanitation, and not let the fly larvæ do it for us. This is the root of the matter. There are certain palliatives, which are, however, not to be neglected, for I am not so sanguine as to expect to see the domestic fly banished from our midst; we must expect to see some, even though in reduced numbers. It is possible to exclude flies from dwellings by fly-proof doors and windows but at the expense of diminished light and air. We should at least exclude them from our food, and more particularly keep them out of the milk-jug. A small piece of mosquito-net, weighted round the edge with glass beads is sufficient for the purpose. All fæcal matters should be well-covered from flies, and the further addition of some disinfectant whose odour is disagreeable to the fly is a precaution not to be despised. In country districts where cowdung and horsedung are abundant, and inhabitants are few, palliative measures are, I fear, all that can be adopted.

While this method of conveyance of disease-germs by flies and other insects is probably more common than is generally suspected, there is a second class of instances in which the insect plays a more important role. In these the disease-germ is conveyed, not by accidental contact with the outer surface of the insect, but in its interior, and is inoculated into the body of the affected animal by the bite of the insect. Of these many examples are now known, from which I will select a few of those which have been most thoroughly investigated in connection with the human subject.

### MOSQUITOS AND FILARIA.

Considerations of time will prevent me from more than a passing reference to the propagation of filarial disease by the mosquito. It is of interest, as being the first disease in man, which was proved to be conveyed exclusively by the bite of an insect, in this instance the common House Mosquito, *Culex fatigans*. The adult worm, which was first discovered by a member of this Society, the late Dr. Joseph Bancroft, inhabits the lymph vessels of man. Its embryos are discharged in myriads and through the

lymphatics, enter the blood stream, where they may be discovered in the blood of the superficial vessels during evening or night, as minute lively motile worms, disappearing in the daytime. *Culex fatigans* is a nocturnal insect, and bites during the hours when the filariæ are near the surface. Sir Patrick Manson, many years ago, discovered that the embryo filariæ escape from the stomach of the mosquito and develop in its thoracic muscles, increasing largely in size. This discovery has been confirmed by many later observers, among whom I may name Dr. Thomas Bancroft. More recently it has been shown that the larvae, when sufficiently grown, penetrate from the thorax of the mosquito into the proboscis, and from thence enter the blood stream of the human subject during the act of biting.

### MOSQUITOS AND MALARIA.

Since the earliest beginnings of medical science it has been known that the inhabitants of certain districts, and visitors to those districts, are peculiarly liable to attacks of fever, characterised by their intermittent or remittent course. To these many different names have been given, such as ague, splenic fever, intermittent or remittent fever, paludism, malaria, besides a large number of local names derived from the districts in which fevers are prevalent. Though largely confused with other fevers, they had certain peculiarities, such as a frequent tendency for the attacks to recur at daily intervals, or on alternate days, or every third day, the so-called quotidian, tertian, and quartan agues. As a rule these attacks recurred at the same hour of the day, and often ran through three stages, more or less defined, the cold, hot, and sweating stages. It was also well-known that those who had suffered from such attacks were very apt to suffer from them again, even after long intervals of time, and removal to healthy districts, where the disease was not known to occur. Again, those who had suffered much from these attacks were known to develop an enlargement of the spleen, and, when microscopical examination became a method of research, deposits of minute particles of a blackish pigment were found in the spleen and other organs after death. In the seventeenth

century it was discovered that the attacks were preventable by the administration of large doses of quinine, and that the disease could be in most cases cured by the use of this drug. This discovery was valuable, not only for its therapeutic effect, but in differentiating malarial from other fevers, which were not influenced in the same way by quinine. But it threw no light on the causation of malaria, as to which the only thing really known was that it was a *place disease*. As to what peculiar feature of the locality was responsible there were various theories. One ascribed it to something in the drinking water, and this seemed to be supported by the fact that many fever districts were marshy, and that some had been freed from fever by drainage. But the most prevalent opinion was that malaria—as its name implied—was propagated through the atmosphere, and that the air was contaminated by exhalations from the soil of certain districts. But these exhalations were mere suppositions, and the various theories were gropings in the dark without a real clue.

The first ray of light came in 1880, from M. Laveran, a French physician working in Algiers. Laveran discovered peculiar bodies inside the red-blood corpuscles of patients suffering from malarial fevers, and recognised them to be the parasites that caused the disease. This discovery was at first received with considerable scepticism. The parasites were inconspicuous and hard to find. Though many diseases were known to be due to various bacteria, these parasites were protozoa, belonging to the animal kingdom, very different to bacteria, and incapable of cultivation outside the human body. Nevertheless, by the labours of many observers, the life-history of the parasites inside the human body was thoroughly worked out, and their causal relationship to the disease sufficiently established. The earliest stage of the parasite is a minute colourless protoplasmic speck inside the corpuscle. It shows active amoeboid movements, and gradually increases in size at the expense of the corpuscle, at the same time developing blackish specks of pigment in its interior. After reaching full size it begins to show signs of segmentation, and assumes the rosette form. Finally the rosette separates into a number of minute spherules or spores, the corpuscle breaks down,

and the spores are liberated. Many of them are swallowed by the phagocytes of their host, but some escape and contrive to enter fresh red cells, in which the cycle of development is renewed. It is a very significant fact that the parasites may be present abundantly in the blood during the period in which the patient is free from fever, but the febrile paroxysm follows immediately on the stage in which the spores are liberated from the broken-down corpuscles. The intervals between the paroxysms and the frequency of their recurrence depend on the life-history of the parasites. Of these, there are several varieties differing slightly in their morphology, and considerably in the symptoms of the disease, which they cause. Into these differences we need not enter; in the main points the various parasites are closely similar.

Though the discovery of these facts was a notable step in advance, we were nearly as far as ever from understanding the causation of malaria. In what way, and under what conditions do the parasites enter the human body? For the answer to these questions we are mainly indebted to two British observers, Sir Patrick Manson and Sir Ronald Ross. Manson, starting from the proposition, that every parasite has some way of getting out of the body of its host, drew special attention to a remarkable form of the parasite, which had been previously discovered by other observers, without its true significance having been recognised. This is the so-called flagellate body. It is never found in blood freshly drawn, but appears only when the blood has been exposed to examination for some time after withdrawal. In such a preparation some of the parasites may be observed to slip out of their containing corpuscles, assume a rounded form, and suddenly project a half-dozen long whip-like arms, which perform rapid lashing movements, and finally break away and swim freely in the serum.

This striking phase in the history of the malaria organism was rightly regarded by Manson as the first phase in its extra-corporeal life-cycle, and he suggested that this stage of its life was passed in the tissues of the mosquito, and that from the mosquito the parasite in some way again entered man. A young Indian army surgeon, Ronald

Ross, was so much impressed with Manson's theory that he determined to verify the transmission of the malaria parasite by the mosquito if possible. His first observations were encouraging. He found that the process of exflagellation occurred in blood taken into the stomach of a mosquito much more freely than under other conditions. But here his progress stopped. He was not able to trace any development of the separated flagella, nor could he find in the tissues of mosquitos which had bitten malarious patients, any parasites that could be identified with the malaria organism. The research was an arduous and difficult one. He could not know what the organism he was looking for would be like, that is to say what form the malaria organism would assume in the mosquito. Again he could not know what species of mosquito, if any, were concerned in the matter, and at that time very little was known of the genera and species of mosquitos.

For two years, with admirable zeal and perseverance, Ross devoted his spare time to this quest, and dissected and microscoped many hundreds of mosquitos without success. Then having by chance obtained a few specimens of a mosquito hitherto unknown to him, and having fed them on malarious blood, he found on dissection, several days later, some round pigmented cells in the stomach of the mosquito. Such cells he knew were not normally present in the stomachs of mosquitos, and at last he had found his clue. Unfortunately, at this stage, official duties prevented his carrying the research further, and the next ray of light came from an American observer, MacCullum. MacCullum observing a parasite in the blood of birds, the halteridium, which is allied to that of human malaria, found that after exflagellation, the separate flagellæ swam about until they encountered and fused with certain rounded forms of the parasite, and that these thereupon assumed a vermicular form and exhibited active movements. That in fact the process was one of sexual conjugation, followed by a fresh stage of development.

At this stage, the Indian Government took a very enlightened step. They relieved Ross of his military duties, and sent him to a well-equipped laboratory in Calcutta to investigate the mosquito-malaria theory. It happened



to be the wrong season of the year for malaria, but nothing daunted, Ross commenced to investigate a closely allied organism, the *proteosoma*, found in sparrows. He had no difficulty in proving that round pigmented cells appeared in the stomachs of mosquitos that had fed on infected birds, just as he had formerly observed in malaria. He followed the development of the parasitic cells and found they gave rise, by internal sporulation to a number of fine rod-like spores which escaped into the tissues of the insect. And now came his crowning discovery. Dissecting an infected mosquito, he came upon two small glands connected by a duct with the proboscis. To his astonishment, he found the cells of these glands packed with enormous numbers of these parasitic rods. The inference that these rods were intended to pass with the secretion of the salivary or poison gland into the next bird bitten by the mosquito was obvious. He subjected it to the test of experiment, and found that birds whose blood was free of *proteosoma*, could be certainly infected by the bite of such mosquitos. That the malaria organism had a similar life-history appeared almost certain, and an Italian observer, Grassi, soon after confirmed Ross's conclusions with regard to this parasite.

The study of mosquitos was until recent years a much neglected province of entomology. But since Ross's discovery, so much attention has been given to the subject, that they are now among the most completely known families of insects. We now understand the reason of Ross's early failures in his investigation. Mosquitos may be divided into two groups—the *Culex* group, which comprises the great majority of forms, both in individuals and species, and the *Anopheles* group, which are far less noticeable by the casual observer, and yet are exclusively concerned in the propagation of malaria. Without entering into technical details, it is easy to enable anyone to recognise the difference between members of these two groups, both in the larval and mature stages. Mosquitos of the *Culex* group have the larval form which is so familiar to us in our domestic water. These little wrigglers are, of course, air breathers, and ascend to the surface of the water to breathe through a conical projection, called the

siphon, situated towards the tail, while the head hangs nearly vertically downwards. *Anopheles* larvae have no projecting siphon, and rest nearly horizontally on the surface while breathing. The mature *Culex*, when it alights, rests with the body horizontal, and the head well elevated. *Anopheles* rests with the body steeply inclined, and the head depressed, as though the proboscis was pinned into the surface rested on. The species are more quiet and retired in their habits than those of the *Culex* group, and need to be searched for, while the latter make their presence evident, whether we wish it or no.

We are now able, thanks to the work of later observers, to give the complete life-cycles of the malaria organism both in man and the mosquito. First we have the asexual circle as already described, occurring in the blood of the human host. It is now known that sexual forms also occur in human blood. They are most easily distinguished in the pernicious variety of malaria, where they are sausage-shaped, distorting the containing corpuscle to form the familiar "crescent bodies." The male and female forms can be distinguished by slight differences in the size and staining of the nuclei and cell granules. Confined to the human body, the male forms undergo no further development and die out. The female forms are more resistant, and indeed are capable of surviving when all the remaining forms of the parasite are killed off by quinine, or by the natural resistance of the host. When, however, this resistance is lowered by some external cause, such as a chill, they undergo a parthenogenetic development. The nucleus divides into two parts, the darkly staining portion divides into spores as in the asexual cycle, the paler portion which represents the sexual element is abandoned as useless to the organism. Meanwhile the unfortunate host experiences a relapse of his ague.

But when the blood is imbibed by a mosquito, the course of development is altogether different. The digestive juices of the insect destroy all but the mature sexual stages of the parasite. The crescents slip out of their corpuscles, and assume a rounded form, and undergo development. The nucleus of the male is transformed into the threads commonly known as flagella, but more accurately termed

*microgametes*. These, four to six in number, are rapidly shot out from the surface. They contain the nuclear chromatin, that is the portion concerned in reproduction, and lash wildly about, finally breaking away and swimming in a serpentine fashion, until they find and conjugate by fusion with one of the female cells. The fertilised cell develops into a rather elongate motile worm-like individual, which pushes its way through the epithelial lining of the mosquito's stomach. There it becomes a spherical, motionless rapidly-growing cell in a cyst-like envelope. The nucleus divides as it increases in size, and each daughter-nucleus again divides until the cell becomes filled with a crowd of spores, from some hundreds to over ten thousand, which are set free by the bursting of the cyst. The spores are minute spindle-shaped actively motile bodies. They are carried in the body-fluid of the mosquito until they reach its salivary or poison glands, which are filled with them. When the mosquito next takes a feed they pass down its proboscis into the blood-vessels of the man bitten. In his circulation, they develop according to the sexual cycle from which we started.

Now that this really marvellous life-history has been fully elucidated, there can be no doubt in the mind of any biologist that malaria is propagated by the mosquito; and we have no evidence that it can be propagated in any other way. This conclusion has been confirmed by rigorous experiment. Mosquito-proof huts have been erected in the most malarious parts of the Roman Campagna, and observers living in them throughout the fever season, have remained free from malaria. On the other hand, mosquitos which have been allowed to bite a malarious patient in Rome have been sent by post to London, and have there successfully infected an Englishman, who had never visited a malarious district. Already the knowledge acquired has borne practical fruit. We may free a district from malaria (1) by treating *all* the inhabitants of a district, including especially all the children, by quinine in sufficient doses to exterminate the malaria parasites in their human cycle. This method has been pursued with some success by Professor Koch, but the difficulties in pursuing it with thoroughness are immense, and unless thorough it is useless.

(2) By isolation of all infected by mosquito netting. This is impracticable. To some extent the healthy may be protected by netting, but the isolation from mosquitos is difficult to sustain. (3) By exterminating the *Anopheles* in its larval stage (a) by drainage (b) by screening all domestic water, and (c) by periodical spraying of all exposed feeding places with some form of petroleum. In this way various places have already been freed from malaria, if not entirely at least for the greater part. No doubt the task before the sanitarian is immense, but malaria is no longer inevitable. If we continue to suffer, it will not be for lack of scientific knowledge, but because of the ignorance, indifference and indolence of mankind.

### MOSQUITOS AND YELLOW FEVER.

As Yellow Fever is fortunately unknown in this part of the world, it is necessary to give you some idea of what the disease is. This can be best done by comparing it to a disease with which most of us are familiar—Dengue. Like that disease, it has a sudden onset with fever, shivering, headache, pains in back and limbs, nausea, vomiting, and other symptoms. This stage lasts from a few hours to a few days, and is followed by a remission, known as the stage of calm, in which the symptoms subside. In favourable cases, this is succeeded by convalescence, but in others the temperature again rises, jaundice develops rapidly, and in bad cases altered blood is ejected from the stomach—the “black vomit”—bleeding occurs into the skin or other organs, or from the kidneys, and the patient dies. Like Dengue, it attacks a large proportion of the population, but unlike that disease it is fatal in a large proportion of cases, from 15 to 85 per cent. The towns of the Southern United States have been frequently the seat of epidemics. In New Orleans, in 1853, there were 29,020 cases, with 8101 deaths. In 1793, the town of Philadelphia contained 40,144 inhabitants, of whom 4,041 died of yellow fever—just one-tenth. I will not harrow you with details of these epidemics, I mention these facts merely that you may realise the importance of the question, that for over a century puzzled the medical profession of the United States, the question as to how yellow fever was spread. At first it

was held by the great majority to be a contagious disease, communicated directly from the sick to the healthy. This was of course the belief of the general public, and a general dread of infection and fear of approaching the sick added much to the horrors of the epidemics. But many facts appeared to controvert this theory of direct contagion, and gradually the opinion that yellow fever was a non-contagious and non-communicable disease became prevalent among the profession. This theory, however, failed to explain all the facts, and after much controversy, a middle position became generally held—that while not directly communicable from the sick to the healthy, yellow fever was spread by emanations from the sick which required a suitable nidus in which to germinate and develop before they attacked the healthy, and that this nidus was furnished by clothing, furniture and various articles of merchandise to which collectively was applied the term *fomites*.

This was the received theory in the year 1900. Many investigations had been made to discover the causal organism of the disease, but none had succeeded, though several observers had isolated organisms which were at first supposed to be those sought for. Meanwhile, the disinfection of fomites was the official weapon with which epidemics were combated. Dense ignorance prevailed as to the real mode of spread of the disease, and on this ignorance was based an official routine which was of small value for the purpose for which it was intended.

In this year, 1900, yellow fever appeared among the American troops in the island of Cuba, and a commission of medical officers of the United States Army was appointed to investigate the etiology of the disease. The head of this commission was the late Walter Reed, a U.S. Army surgeon, and to him we owe our present knowledge of the propagation of yellow fever. He was to some extent anticipated. Dr. Carlos Finlay, a physician of Havana, had promulgated the theory that yellow fever was spread by mosquitos, without, however, producing any cogent evidence in its favour, and he had few if any adherents. Nevertheless, some observations made by Reed on an epidemic in some barracks near Havana disposed him to believe that Finlay's theory had much to commend it, and was at least worth

investigating. The true nature of this outbreak had not been recognised until 35 cases had occurred, with 11 deaths. No precautions had therefore been taken with regard to the disinfection of bedding and clothing; but the disease had not been contracted by the nurses nor by the men who washed the clothes. Indeed a little inquiry showed the presence of contaminated clothing in all of the eight barrack-rooms without apparent detriment to the occupants. This threw grave doubt on the accepted theory of propagation by infected *fomites*. Yet at the same time, a prisoner who had been in strict confinement in a cell of the guardroom for seven weeks contracted the yellow fever. Eight other prisoners in the same room escaped infection, though one of them continued to occupy the bunk vacated by the sick man. It was exceedingly difficult to explain this isolated case, but it was conjectured that some insect capable of conveying infection, perhaps a mosquito, had entered through the cell window, and bitten this particular prisoner. This was of course, merely a supposition, but it was not apparently possible to explain the case in any other way.

It seemed therefore advisable to Dr. Reed that the scheme of work planned out by the commission should be altered, so that its chief endeavour should be turned to the proving, or disproving the agency of the mosquito as an intermediate host in the spread of yellow fever. Fortunately, the mosquito selected for experiment, the *Stegomyia fasciata*, proved to be the right one. As the experiments proposed involved grave danger to life, it was considered that the members of the commission should run the risk themselves, before subjecting anyone else to it. The first successful experiment was performed on Dr. Carroll. The insect, which had been hatched and reared in the laboratory had been caused to feed on four cases of yellow fever, twelve, six, four and two days previously. Carroll duly contracted a severe attack of the disease from which his life was in the balance for several days, but eventually he recovered. Another member of the commission, Dr. Lazear, subsequently succumbed to a fatal attack after being bitten by a mosquito in the fever ward, but in his case the infection was an accidental one, and not having

been made under rigorous scientific conditions, it could not be proved that the mosquito had actually conveyed the disease. Eleven other experiments similar to that on Carroll were made; of these nine were negative, two positive. The negative experiments might be explained in several ways. The cases of yellow fever through which the mosquitos were infected were very mild, and the infection might not have been sufficiently virulent; or the interval between the two bites might not have been the right one. The positive experiments could not be explained away. A *prima facie* case for the mosquito as the intermediate host for yellow fever had been made out.

It remained now to subject the mosquito theory to a fresh trial on a larger scale and under rigorous conditions. Fortunately for the commission, the then military Governor of Cuba, Major-General Leonard Wood, was an officer formerly in the medical service, and his scientific training enabled him to comprehend the nature of the experiments proposed, and to appreciate their importance. It is the common fate of scientific investigators to be misunderstood, and to find their work starved by the false economy, or thwarted by the interference of high government officials. In this instance, however, every assistance required was liberally furnished. An isolated camp was established, volunteers from the U.S. Army were called for, and offered themselves freely, though fully informed of the risks that they would run. One cannot refrain from noting the very high courage shown by those who thus voluntarily risked their lives in a campaign more calculated to inspire fear than many military operations. Those in the camp were subjected to strict quarantine, so that the possibility of accidental introduction of infection might be excluded. The pulse and temperature were taken thrice daily, so that any that might be incubating the disease should be at once detected, and this was continued until they had passed the full period of incubation of yellow fever, without developing any symptoms. Two buildings were erected in the camp, of similar size and construction, except that one known as the "Infected Mosquito Building," was divided in the middle by a permanent wire screen partition, and was well ventilated. The other known as the "Infected

"Clothing Building" was purposely so built as to exclude efficient ventilation. Both were provided with wire screen windows, and double wire screen doors, so that mosquitos could be kept within or without the buildings, as the experimenters might desire.

The results of the experiments may be very briefly summarised. Non-immune subjects exposed to the bites of mosquitos that had previously bitten yellow fever patients were readily infected, provided the interval between the bites were at least twelve days. Before that interval the mosquitos were harmless, but they maintained their virulence for as long as eight weeks. Control subjects separated from the mosquitos in the same room by a wire partition remained uninfected. Meanwhile, in the "Infected Clothing Building," non-immune subjects lived and slept among clothing soiled by the discharges of yellow fever patients, and even wore the very shirts in which these patients had been clothed, for so long as twenty days without a single instance of infection. This experiment disproved the virulence of "fomites" in yellow fever. The problem of the method of transmission of yellow fever had been solved in the most conclusive way.

The practical importance of this discovery is immense. Yellow fever epidemics can now be stamped out. The method is simple. As soon as a case of the disease is notified, the patient is promptly isolated by wire screens, so as to prevent the possibility of mosquitos becoming infected from him. At the same time, the whole house is fumigated so as to destroy any mosquitos that may have already become infected. In addition, a "mosquito brigade" is organised to destroy the larvae of *Stegomyia fasciata* in their breeding places throughout the town. This mosquito is, I may observe, very abundant in Brisbane. We breed it in our water tanks, and if ever a case of yellow fever is imported here, which in these days of rapid travelling is not impossible, every condition is present to favour the occurrence of a considerable epidemic. We may then realise more fully the value of Dr. Reed's experimental work.

All the evidence at our disposal fails to indicate that yellow fever is spread naturally in any other way than



that I have described. But it may be communicated artificially by the direct inoculation of the blood of a patient suffering from the disease. Nevertheless, the most refined microscopical and cultural methods have not been successful in revealing in this blood the living organism that causes the fever. The germ of yellow fever still remains undiscovered. There is indeed good evidence that it is ultra-microscopic, for, unlike the smallest living organisms discovered by the microscope, it passes through the pores of a Berkefeld filter. The discovery of its method of propagation depends entirely on experiment, and is indeed one of the best instances of the application of the experimental method in medicine. As such, it is one of the greatest triumphs achieved in modern times in the prevention of one of the most deadly epidemics known to afflict mankind.

### RATS, FLEAS, AND PLAGUE.

Early in 1900, Australia was invaded by the plague. Human nature is so constituted as to tolerate with indifference and apathy those epidemic diseases which are familiar, but to fly into a panic at the mere report of those which are novel. In the present instance, panic was doubly inevitable, for the plague had been practically unknown for centuries among European peoples, and the very name was charged with the vague terrors of old epidemics; and particularly with recollections of the great plague of London in the seventeenth century, described by De Foe, an author distinguished for his talent in writing fiction so realistic in style, as to be indistinguishable from the facts, which are no doubt imbedded in his narrative.

At this juncture, I was appointed a special medical officer by the Government to advise and report regarding the epidemic in Northern and Central Queensland, some cases of plague having been reported in Rockhampton and Townsville. My first duty was to visit Sydney, where plague had been rife for several months, to acquire information. The situation, as I found it in that city, was certainly remarkable. On the one hand were a populace and a Government treating plague as a virulently infectious disease to be stamped out at any cost, regardless of expense,

private interests, and public convenience. In pursuance of this policy, every occurrence of plague was notified to the police, and not only the patient, but every one on the premises, and in the case of an hotel, their number might be considerable, was conveyed to the Quarantine Station, on the other side of the harbour. These proceedings certainly made a great stir, and had an appearance of energy. But I found to my surprise that the highest authorities in the Department of Health held views as to the epidemiology of plague, which were, to put it mildly, hardly consistent with these administrative measures. To them the infectiousness of plague from patient to patient was very problematical, and played very little if any, part in spreading the epidemic. They regarded plague rather as a disease of the rat, occasionally communicated to mankind, probably by the bite of rat-fleas, and therefore requiring for its prophylaxis entirely different measures from those that I have described. While excellently devised to stamp out an epidemic of small-pox, isolation and segregation of contacts were, they considered, quite inoperative in the case of plague, except in so far as they facilitated the cleansing of affected dwellings and areas and the destruction of rats.

To understand how this position was arrived at, we must briefly recapitulate the position at that time of scientific knowledge regarding plague. The discovery of the bacillus of plague was made in Hongkong in 1894 by Kitasato and Yersin, and since then there has been no room for doubt that the *bacillus pestis* is the causal organism. But its method of spread from case to case long remained a matter for conjecture. One of the characteristics of the plague organism in artificial culture is its slight power of resistance to unfavourable conditions. It behaves in the laboratory rather like a frail exotic, and in mixed cultures is readily killed out by more vigorous saprophytes. It does not survive long when dried in the ordinary way, and the conjectures that plague may be due to food or soil contamination had never any solid foundation. Again on the assumption that the disease is infectious it is difficult to understand how the bacilli make their exit from the patient. Certainly, in the rare cases of pulmonary plague, the bacilli are con-

tained abundantly in the sputum, and these cases are extremely infectious, as was shown in the small outbreak in Maryborough, in 1905. But in bubonic plague, and even in the septicaemic form, there does not appear to be more than an occasional and trivial exit of the bacillus, and in these cases, which form the vast majority, plague has been found by experience to be non-infectious.

It has been known for a long time that true plague is not a disease limited to the human species. Not only can many, we might say most or all mammalia, be infected by artificial inoculation, but the disease has in many species occurred under natural conditions. Especially is this the case with rodents, and among them the species of *Mus* that are associated with mankind are affected above all others. It has been found in Australia that epizootics of rat-plague have accompanied and preceded outbreaks of human plague, and this has been so also in many other parts of the world. It has been the case so uniformly, wherever adequate research has been made, as to suggest a causal connection between the epizootic and the epidemic. That is to say that plague is primarily a disease of the rat, communicated from rat to rat, and incidentally communicated, when the conditions are favourable, from rat to man. Now it is obvious that the conditions under which plague spreads naturally from rat to rat are open to experimental investigation, and if these were satisfactorily established, much light might be expected to be thrown on the occurrence of the disease among mankind.

The first direct experimental evidence as to the natural method of rat infection was obtained in Bombay, in 1898, by Simond, who showed that plague could be conveyed from one rat to another, not allowed to come into contact with it, provided fleas were allowed to pass from the infected to the healthy rat. He observed that on rats suffering from natural plague fleas were usually abundant, and that the fleas that left a rat which had died of plague contained virulent plague bacilli. Plague in man, he attributed to the infected persons having been bitten by fleas which had left a plague rat. This conclusion was strongly supported by an epidemiological study of the epidemic in Bombay, by Hankin, published in the same year. This rat-flea

theory of plague formed the working hypothesis adopted in Sydney in 1900 by Ashburton Thompson and Tidswell, and considerably strengthened by their observations.

In other parts of the world, however, this theory was received with less favour. Some observers flatly denied that rat-fleas would bite human beings. An Indian Plague Commission came to the conclusion "that Simond's proposition that suctorial insects play an important part in the transmission of plague from sick to healthy animals is so weak as to be hardly deserving of discussion." The more recent investigations of Gauthier and Rayband in Marseilles, of Liston in India, and especially of an Indian Plague Commission at present working in Bombay, whose preliminary reports were published in 1906 and 1907 have placed the rat-flea theory in an absolutely incontestable position as the natural method of plague infection. Let me briefly summarise the present state of our knowledge.

The species of *Mus* concerned are three :—

(1) *Mus rattus*, the Black or Old English Rat now almost exterminated in Great Britain by the Brown rat, but still abundant in countries in which plague has become endemic. This rat is a nimble climber, and lives in houses, preferring the space under the roof. It is also the common rat on ships. It has a reddish variety, known as the Alexandrine Rat—*Mus alexandrinus rufus*.

(2) *Mus decumanus*, the Grey, Brown, or Norway rat, which is a heavier, but clumsier animal, and lives especially in sewers and drains, from which it invades the basements and cellars of houses.

(3) *Mus musculus*, the Mouse. Of these, the last appears least susceptible to plague, and the number found to be infected is comparatively small. The two former are both extensively infected during the epizootic, but as Dr. Ham shows in his recent admirable report on the Plague in Queensland, *Mus rattus* and its variety *alexandrinus* is most concerned in the spread of plague in man, owing to its predilection for human habitations.

So much for the rats. Special attention has been devoted of late to the study of rat-fleas, and the flea which has been proved to be the carrier of plague has been discovered to be a species almost unknown in temperate

Europe, but common in warm climates, which was till recently undescribed, but is now known as *Pulex cheopis*, Rothschild. Several species of flea are found on rats. The human flea, *Pulex irritans*, and the dog-flea, *Pulex serraticeps*, are occasionally found, but merely as stragglers. There are three species specially attached to the rat, known as *Ceratophyllus fasciatus*, *Ctenopsyllus musculi*, and *Pulex cheopis*. Much experimental work has been vitiated by neglecting to identify the species of flea concerned.

*Pulex cheopis* is nearly allied to the human flea. That it will readily bite man has been ascertained repeatedly. The statement that rat-fleas will not bite man are derived from experiments with the other species. It can indeed be kept alive for weeks by being allowed to suck human blood. Furthermore, it has been found on man. For instance, Liston writes, "About the 6th or 7th of April, rats began to die in large numbers in a chawl, or block of tenement houses. Suddenly the deaths among rats ceased, and on April 11th, the people became troubled with fleas. The fleas became so numerous that they had to quit their rooms and sleep out on the verandah. While living on the verandah on April 17th, one of the inhabitants of the particular room in which the fleas were taken became infected with plague. Another case occurred on the same day in a room adjoining. The people who inhabited the room where the above case occurred, were induced to collect some of the fleas. An examination of this collection was most instructive. Now I must tell you that on previous occasions, of 246 fleas that were caught on man under normal conditions, I had found only one rat flea, *Pulex cheopis*. But of the collection of 30 fleas caught on man under the circumstances above recorded, no less than 14 were rat fleas."

Though the geographical distribution of the rat-flea has not yet been worked out, there are indications that the freedom of certain ports from plague infection are due, not to any unusual vigilance in their port authorities, nor to any superior excellence in their sanitary conditions, but merely to the scarcity or absence of this particular flea on the local rats.

Let me now give a summary of the experimental

evidence from which we know that plague is propagated by *Pulex cheopis* :—

(1) Two wire cages are placed in a glass box. The cages rise above the level of the box, and both box and upper portion of cages are covered with fine muslin impervious to fleas. In case A. is placed a rat inoculated with plague, together with 10 to 20 living *Pulex cheopis*. As soon as the rat is dead, a healthy rat is placed in cage B. There is no direct contact between this and the first rat, nor with its excretions. The rat in cage B. develops plague. Some of the fleas are to be found on rat B. on examination. This experiment has been repeated many times.

(2) A rat is inoculated with plague. After death, it is searched for fleas. These are caught and transferred to a flea-proof cage containing a healthy rat. The latter dies of plague. On it are found some of the fleas, and in the fleas are plague bacilli. This experiment has been repeated many times.

(4) Simond, Gauthier and Rayband, and Liston never succeeded in infecting animals from one another when healthy and plague-infected animals were confined together in the same cage if fleas were excluded, and if the animals were not allowed to devour the bodies of their dead comrades. The recent Indian Commission verified this on a large scale. Fifty healthy guinea-pigs were confined with ten inoculated with a plague culture under flea-proof conditions. The latter all developed plague, but none of the former. The same experiment was repeated. One of the uninoculated animals developed plague. The animals were examined, and one rat-flea was found. The other forty-nine uninoculated escaped. Forty-nine guinea-pigs were confined, with ten inoculated guinea-pigs, rat-fleas being known to be present. In seventeen days, every guinea-pig was dead of acute plague. From the last two animals four-hundred fleas were recovered. And so on with similar experiments. For instance, guinea-pigs placed in a cage in a compartment where a guinea-pig plague epizootic was in progress, frequently contracted plague if the cage was suspended two inches from the floor, and fleas were found on them ; but if suspended two feet from the floor, remained free from both plague and fleas. The rat-flea cannot jump two-feet

high. A similar experiment was performed with two monkeys placed in cages of similar pattern, one unprotected, the other surrounded by a layer of "tanglefoot," six-inches wide. After two nights they were removed. Two fleas were caught on the unprotected monkey, while five fleas were found stuck on the "tanglefoot." The first monkey developed bubonic plague, the other remained healthy.

(5) Guinea-pigs were let loose in houses in which cases of plague had occurred recently. Large numbers of *Pulex cheopis* were subsequently collected from these guinea-pigs, and they died of plague. If, however, the guinea-pigs were in cages protected by flea-proof gauze, they escaped plague. In similar cages not protected with gauze ten per cent. of the guinea-pigs contracted plague, and fleas were found on them, though in fewer numbers than on the guinea-pigs that were allowed to run about.

This evidence is conclusive. For further details, I must refer to the original report. But one point must be mentioned. Rats can be infected by feeding on plague-contaminated material, for instance, the bodies of their dead comrades. In these cases, there are well-marked pathological lesions in the intestines and mesenteric buboes. In naturally infected rats, intestinal lesions and mesenteric buboes were not found in 5,000 infected animals examined. The Commission conclude that transmission by feeding is not of common occurrence in nature, and is not the method by which the epizootic is propagated.

We find then that plague epizootics among rats are propagated by a particular flea, *Pulex cheopis*. This flea leaves the rat soon after death, with its stomach engorged with blood, swarming with plague bacilli. In default of its natural host, it will fasten on other animals, and biting them will infect them with plague. This is not true only of other rodents like the guinea-pig, but of an animal widely remote from the rat and akin to man, the monkey. *Pulex cheopis* will bite man freely. The inference that plague may be and is conveyed to man from the rat by this particular flea is inevitable. With the exception of plague pneumonia, there is no reason for supposing that plague is naturally acquired in any other way. How well this

conclusion agrees with the epidemiology of plague as observed in Australia, may be learnt from the able reports issued by Dr. Ashburton Thompson and Dr. Ham.

I have sufficiently transgressed on your patience, but did time permit I might give you details of yet other diseases of mankind spread by insects, for instance, the sleeping sickness, which is spread by a species of tsetse fly, and the spirillar fever of West Africa, which is spread by the bites of a species of tick. If diseases of domestic animals were included, we might study the tsetse-fly disease of cattle and horses in Africa, or the tick-fever of cattle, which is so unfortunately familiar in our own country. But this would be too large an undertaking for the present occasion.

It is probable that the list of human diseases spread by insects will be extended in the future. Among diseases which are probably so spread, I may mention Dengue and Leprosy. The organism of Dengue is unknown; the reasons for connecting it with mosquitos are (1) its similarity to yellow fever, and (2) certain peculiarities in the spread of epidemic, which suggest that, in the beginning of an epidemic at all events, it is a *house disease*. The hypothesis that leprosy is spread by insect bites is a very old one. The leprosy bacillus has been long known, and can be easily demonstrated. But it cannot be cultivated outside the body, and unfortunately, it cannot be made to grow in any animal but man. The long period of latency renders it peculiarly difficult to trace the source of infection, and as the experimental method can hardly be applied, no speedy increase in our knowledge is to be expected. With regard to Dengue, the application of the experimental method used by Reed in yellow fever is much to be desired.\* If the propagation by the mosquito were proved, we might stamp out such an epidemic as vexed us in 1904. Few things have struck me more this summer than the disgraceful number of mosquitos in the houses I visit in Brisbane. I say disgraceful, because by adequate screening of domestic water tanks (which is easy, but seldom done), or by the

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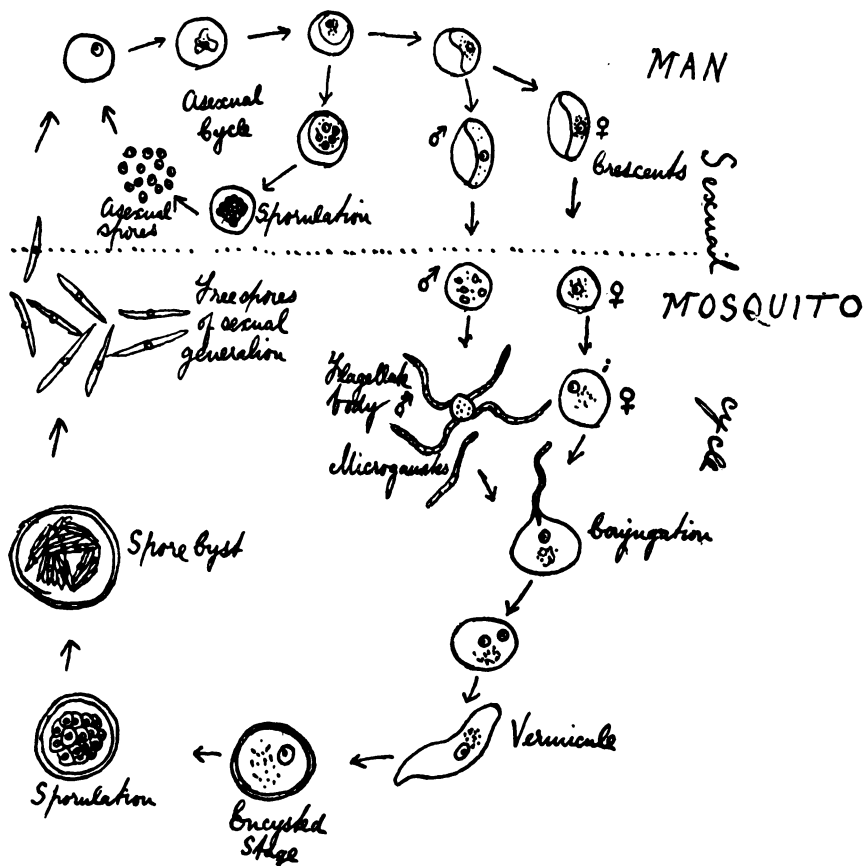
\* Since writing this I learn that this has actually been carried out by American observers in the Phillipines, and the connection between dengue and a mosquito is now proved.



addition of a spoonful or two of kerosene to the surface of the water every two or three weeks (which has no effect on its potability), the mosquito nuisance might be readily prevented.

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INTRA-CORPUSCULAR PARASITES.



Asexual and Sexual Cycles of the Malaria organism in Man and the Mosquito.

[AFTER MINCHIN].

Forms above dotted line occur in Man (Asexual Cycle and commencement of Sexual Cycle).

Those below in Mosquito (Sexual Cycle).



# Annual Meeting of Members,

The Annual Meeting was held at the Technical College, Ann Street, on Monday, January 27th, 1908. The President, Dr. A. Jefferis Turner, occupied the chair.

Minutes of last Annual Meeting were read and confirmed.

The Report of Council and Financial Statement for 1907 were read and adopted.

*To the Members of the Royal Society of Queensland.*

The Council of the Royal Society of Queensland have pleasure in presenting the Annual Report for the year ending 31st December, 1907.

Twelve new members were elected during the year, and thirteen resigned, left, or were struck off the roll, leaving the membership at 114.

The following names are those of the new members elected since last Report for 1906 :—

Mrs. Hogarth, Miss L. A. Bundock, Mrs. J. B. Henderson, Major J. R. Sankey, Messrs. G. C. Willcocks, F. Pickering, C. W. Holland, J. S. Badger, F. Lord, H. M. Challinor, W. V. Ralston, and F. Smith.

Eight ordinary meetings were held during the year, when the following papers were read :—

February 23rd.—“On the Ways of a Hornet,” *W. J. Young.*

“The Lepidoptera,” *Dr. A. Jefferis Turner.*

March 23rd.—“The Magpie,” *Robert Hall.*

“New Genera and Species of Fishes,”  
*J. D. Ogilby.*

April 27th.—“The Geology of the Glasshouse Mountains,” *J. Shirley.*

“The Keeping Properties of Microscopic Preparations stained with Aniline Dyes,” *C. J. Pound.*

- May 25th.—“Graphical and Mechanical Aids to Calculations,” *J. C. Brunnich*.
- June 27th.—“An Efficient Automatic Sand Filter,”  
*H. Wasteney*.  
“A New Test for Mercury,” *P. W. Jones*.  
“The Detection of Mercury in Explosives,” *J. B. Henderson*.
- July 29th.—“The Forest Trees of Queensland,” *Dr. Alfred Sutton*.
- October 3rd.—“Coral Reefs and their Denizens,” illustrated by natural colour photography, *W. Saville Kent*.
- December 14th.—“The Building of Australia,” dealing with the Origin of our Climate, Fauna, Flora, and Water Supply.  
*Professor S. B. J. Skertchly*.  
“New Genera and Species of Queensland Fishes,” *J. D. Ogilby*.

Interim meetings were also held of a popular instructional character.

Mr. H. M. Challinor was appointed Hon. Secretary on 25th May, in succession to Mr. F. E. Connah, who resigned that office.

Council meetings were held during the year, ten in number, and the attendance of Councillors was as follows: Dr. Turner, 5; J. C. Brunnich, 7; Hon. A. Norton, 9; Frank Smith, 6; J. Shirley, 4; J. F. Bailey, 8; W. J. Byram, 7; F. E. Connah, 10; J. B. Henderson, 8; H. M. Challinor, 7.

Proceedings of the Society, Vol. XX for 1906, together with index to Vol. XIX., were issued to members and kindred exchanging societies.

The state of the library is still far from satisfactory, but a sub-committee is now at work with the view of placing the valuable works and exchanges in better order, and of having them properly catalogued and checked on receipt. An effort to complete the work of binding the loose volumes should be undertaken without delay.

The Government endowment, which was of great assistance to library expenditure, has not been renewed,

but the Chief Secretary's Department has been approached by letter in accordance with a former promise of support made (to a deputation) in the form of free accommodation and also free binding of the books by the Government Printer. This important matter is still in hand, and should be brought to a successful issue at an early date. When this scheme is carried out, it is proposed to make the library available, under proper supervision, to the public.

A number of members are in arrears for subscriptions for 1907, but the financial statement shews a fair credit balance, and monetary affairs of the Society are on a sound basis for the new year's business. There are no outstanding accounts.

The Balance Sheet is hereto annexed.

The balance of outstanding subscriptions in June was a large one, but since then the bulk of it has been collected, and the balance still remaining will, it is expected, be obtained during the current year.

Towards the Queensland University Equipment Fund members of the Royal Society have contributed either directly through the Society, or through other channels, a sum amounting to £558 6s., together with a promise in one instance for further financial support and the endowment of a scholarship. Considering the limited membership of the Society, and the contributions from other sources (the whole total is barely £2,500 announced so far), this will indicate that the members have the vital educational interests of the State well in view, and fully recognise the great desirableness of providing the best possible system of higher education within the reach of young Queenslanders.

The Society was admitted and welcomed to fellowship with the British Science Guild during the year.

Signed on behalf of the Council,—

A. JEFFERIS TURNER,

President.

H. M. CHALLINOR,

Hon. Secretary.

*Brisbane, 27th January, 1908.*

# THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT for Year Ending 31st December, 1907.

Dr.

Cr.

RECEIPTS.	£	s.	d.
To Balance from last report ..	23	5	11
" Subscriptions ..	82	19	0

DEBUREMENTS.	£	s.	d.
By Rent of Rooms ..	12	0	0
" Printing Proceedings, Stationery, etc. ..	34	6	0
" International Catalogue ..	21	7	10
" Postage and Petty Cash ..	9	11	7½
" Library Expenses ..	5	0	0
" Advertising ..	4	4	6
" Engraving for Proceedings ..	1	16	2
" Insurance on Library ..	1	2	6
" Subscription Fellowship British Science Guild ..	1	1	0
" Typing ..	0	19	8
" Bank Charges ..	0	10	0
" Lighting Technical College ..	0	7	0
" Commission to Collector ..	0	2	0
" Balance to Credit ..	12	16	7½
Per Bank Pass Book ..	23	19	11
Less Outstanding Cheque ..	10	2	8½

£12 16 7½

£105 4 11

£105 4 11

Examined and found correct.  
Geo. Watkins, Hon. Auditor,  
Brisbane, 18th January, 1908.

A. NORTON, Hon. Treasurer.

Dr. A. Jefferis Turner then read his presidential address, entitled "Insects and Diseases" (published *in extenso* in this volume), and was accorded a hearty vote of thanks by the meeting.

The following office-bearers for 1908 were then elected: *President*, J. C. Brunnich, F.I.C.; *Vice-President*, J. F. Bailey; *Hon. Secretary*, H. M. Challinor; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Librarian*, Frank Smith, B. Sc.; *Members of Council*, Colonel John Thomson, M.B., P.M.O., Dr. Alfred Sutton, W. J. Byram, J. Brownlie Henderson, F.I.C., J. Shirley, B. Sc.; *Hon. Auditor*, Geo. Watkins; *Hon. Lanternist*, A. G. Jackson.

A vote of thanks to the retiring officers was carried by acclamation.

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## LIST OF MEMBERS.

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Archer, R. S.  
 Badger, J. S.  
 Bailey, J. F. (Life)  
 Bailey, F. M.  
 Bennett, F.  
 Bernays, L. A., C.M.G.  
 Bright, C. E.  
 Brunnich, J. C., F.I.C.  
 Bundock, C. W.  
 Bundock, Miss Alice  
 Byram, W. J.  
 Cameron, W. E.  
 College, W. R.  
 Cory, A. H., M.R.C.V.S.L.  
 Carter, Hon. A. J., M.L.C.  
 Collins, Wm.  
 Costin, C. W.  
 Cooper, Sir Pope A., C.J.  
 Collins, Miss Jane  
 Chapman, R. M.  
 Collins, J. C.  
 Collins, R. M.  
 Connah, Frank E.  
 Challinor, H. M.  
 Cameron, J., M.L.A. (Life)  
 Dunstan, Benjamin  
 Evans, W.  
 Field, W.  
 Fox, Geo., M.L.A.  
 Forrest, Hon. E. B., M.L.A.  
 Forrest, John  
 Galley, R. (Life)  
 Griffith, Sir S. W. (Life)  
 Gross, C.  
 Greenfield, A. P.  
 Gregory, W. C.  
 Gore, Gerard R.  
 Gibson, Hon. A., M.L.C.  
 Gray, Hon. G. W., M.L.C.  
 Ganly, Rev. E. C.  
 Henderson, J. B., F.I.C.  
 Hedley, C.  
 Hirschfeld, Dr.  
 Hockings, P. F.  
 Hopkins, Dr.  
 Hood, W. W.  
 Hogarth, Mrs.  
 Henderson, Mrs. J. B.  
 Holland, C. W.  
 Illidge, T.  
 Irving, J., M.R.C.V.S.L.  
 Illidge, Rowland  
 Jack, Dr. R. L.  
 Jackson, A. G.  
 Jones, P. W.  
 Jones, A. Raymond

Kent, W. Saville (Life)  
 Lindsay, W.  
 Love, Dr. W.  
 Lord, Frederick  
 Lucas, Dr.  
 Leaby, P. J., M.L.A.  
 Leaby, John, M.L.A.  
 Marks, Hon. Dr.  
 McCall, T.  
 MacKie, R. Cliffe  
 May, Dr.  
 Miles, Hon. E. D., M.L.C.  
 Millar, T. W.  
 Murray Prior, Mrs.  
 McConnel, Eric W.  
 McConnel, James H.  
 McConnel, Edward J.  
 Marks, E. O.  
 Nelson, W. M.  
 Norton, Hon. Albert (Life)  
 Pound, C. J.  
 Pritchard, C.  
 Plant, Lieut.-Col. C. F.  
 Parker, W. R., L.D.S.  
 Plant, Hon. E. H. T., M.L.C.  
 Power, Hon. F. I., M.L.C.  
 Rands, W. H.  
 Roe, R. H., M.A. (Life)  
 Reid, Major D. E.  
 Ryan, Dr. J. P.  
 Ralston, W. V.  
 Raff, Hon. Alex. (Life)  
 Shirley, J., B.Sc.  
 Sutton, J. W. (Life)  
 Stevens, Hon. E. J. (Life)  
 Steele, T., F.L.S., F.E.S.  
 Sutton, Dr. A.  
 Slade, W. B.  
 Seabrook, G. K.  
 Scriven, E. G. E.  
 Sankey, Major J. R.  
 Schneider, Harry (Life)  
 Smith, Frank, B.Sc.  
 Turner, Dr. A. Jeffries  
 Taylor, Hon. Dr.  
 Thynne, Hon. A. J.  
 Townley, Capt. W.  
 Tonks, T.  
 Thomson, Dr. John (Life)  
 Watkins, Geo.  
 Weedon, Warren  
 Wasteneys, H.  
 Willcocks, G. C.  
 Walsh, Rev. W. M. (Life)  
 Young, Wm.  
 Zoeller, C.



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